PALEONTOLOGY LIBRARY

Volume 15 MARCH, 1941 Number 2

MAR 10 1941

JOURNAL OF PALEONTOLOGY

A Publication of

The Society of Economic Paleontologists and Mineralogists

A Division of the American Association of Petroleum Geologists

and

The Paleontological Society

An Associate of the Geological Society of America

CONTENTS

New and little known Carboniferous conodont genera . . *E. B. Branson and M. G. Mehl* 97

Revision of the Pennsylvanian conodonts . . . . . *Samuel Ellison* 107

Textularia from the Texas Tertiary . . . . . *Flavy E. Davis* 144

New middle Eocene Foraminifera from southern Alabama and Mississippi . . . . . *J. B. Garrett* 153

A new graptolite horizon in Wisconsin . . . . . *Charles E. Decker and E. A. Frederickson, Jr.* 157

Correlation of Cambro-Ordovician trilobites from Oklahoma . . *E. A. Frederickson, Jr.* 160

PALEONTOLOGICAL NOTES

Graptolites from the Haragan formation (Lower Devonian) of Oklahoma . . . . . *Charles E. Decker* 164

The Silurian of Aroostook County, northern Maine . . . . . *W. H. Twenhofel* 166

Siphonides, a new genus of Foraminifera . . . . . *Dan E. Feray* 174

Type of the Ordovician ostracode genus *Leperditella* . . *H. N. Coryell and Hubert G. Schenck* 176

REVIEWS 178

SOCIETY RECORDS AND ACTIVITIES

Members of the Society of Economic Paleontologists and Mineralogists 184

ERRATUM 191

NOTICE 192

EDITORS

C. WYTHE COOKE, for the Paleontological Society.

NORMAN D. NEWELL, for the Society of Economic Paleontologists and Mineralogists.

The JOURNAL of PALEONTOLOGY is published bi-monthly. The numbers issued in January, May, and September are sponsored by the Paleontological Society; those issued in March, July, and November are sponsored by the Society of Economic Paleontologists and Mineralogists.

The subscription price of the JOURNAL OF PALEONTOLOGY is $6.00 per year prepaid to addresses in the United States.

Single numbers, $2.00 each.

Postage is charged extra for all other countries in the Postal Union, 40 cents on annual subscriptions (total $6.40).

The JOURNAL will furnish reprints at cost. Orders should accompany manuscript.

Communications about the JOURNAL, subscriptions, rates, memberships, change of address, and nonreceipt of preceding numbers should be addressed to Society of Economic Paleontologists and Mineralogists, P. O. Box 979, Tulsa, Oklahoma. Claims for nonreceipt of preceding numbers must be sent in within three months of the date of publication in order to be filled gratis. Communications in regard to advertising should be addressed to Norman D. Newell, University of Wisconsin, Madison, Wisconsin.

Communications in regard to manuscripts, or purely editorial matters should be addressed to Norman D. Newell, University of Wisconsin, Madison, Wisconsin, or C. Wythe Cooke, U. S. Geological Survey, Washington, D.C.

Contributors are requested to instruct their photographers to illuminate fossils from the upper left side, the conventional manner. Plates normally should be arranged for publication at the size of 5 by 7 inches, exclusive of margins, heading, and title. Printed numerals of standard size and form may be obtained free from either editor. When requesting them state number of plates and the dimensions of each plate.

Entered as second-class matter at the Post Office at Tulsa, Oklahoma, under the Act of March 3, 1879. Acceptance for mailing at special rate of postage provided for in paragraph 4, section 538, P. L. and R., authorized April 3, 1935.

Additional entry as second-class matter at the Post Office at Menasha, Wis.

GEORGE BANTA PUBLISHING COMPANY, MENASHA, WIS.

JOURNAL OF PALEONTOLOGY

A Publication of THE SOCIETY OF ECONOMIC PALEONTOLOGISTS AND MINERALOGISTS, *A Division of the American Association of Petroleum Geologists and* THE PALEONTOLOGICAL SOCIETY, *An Associate of the Geological Society of America*

VOLUME 15 MARCH, 1941 NUMBER 2

NEW AND LITTLE KNOWN CARBONIFEROUS CONODONT GENERA

E. B. BRANSON AND M. G. MEHL
University of Missouri, Columbia, Missouri

ABSTRACT—In this paper several Carboniferous genera are described in order to facilitate later descriptions of faunas. Thirteen new species are defined and additions are made to the descriptions of seven old species.

INTRODUCTION

REGARDLESS of the fact that conodont faunas ranging in age from early Ordovician to Permian have been made known, there are still so many gaps in the history of the conodonts that it is difficult to present many generic analyses that promise to remain correct even in their essentials. Often a genus appears in an isolated assemblage and is represented by species that are obviously neither the earliest nor the latest representatives of the genus. In brief, many genotypes have already proven to be atypical in the biologic sense.

It seldom is practicable to delay generic descriptions until the entire history of the genus is understood, but it is with that objective in mind that the following analyses are presented. It was found that in each of the several Mississippian and Pennsylvanian faunas that we propose to describe, one or more new genera appear with more typical representatives in some other conodont assemblage.

STRATIGRAPHIC PROBLEMS

There is some question concerning the exact stratigraphic occurrence of some of the types described in the following paragraphs and an outline of some of the problems involved may aid the reader.

In designating specimens as coming from the Sycamore of Pontotoc County, Oklahoma, reference is made to the terminology in common use among oil geologists. It is not an attempt to correlate the occurrence with the type locality of the Sycamore limestone. The Pontotoc County member was designated as within the Mayes by Hyatt (1936) and some writers would describe it as the lower part of the Mississippian Caney. The exposure from which these types came is in the southcentral part of sec. 35, T. 3 N., R. 6 E., on the south fork of Jackfork Creek. The formation consists of a considerable thickness of brown to black marly shale resting on thick-bedded Welden limestone, from which it is separated by a few inches of highly glauconitic sandy shale of yellowish-green color. This thin layer belongs with the succeeding shales but contains some conodonts derived from the underlying Welden. The conodonts recorded as Sycamore were found in the lower part of the dark shales and in the glauconitic layer, but not in the Welden.

Another record about which there is some doubt is that designated as the Pierson from Roaring River Park in Barry County, Missouri. On the south side of Roaring River at the side of Missouri State Highway 112, the zone involved consists of a red to yellow

calcareous shale member ranging from one to several inches in thickness. This band separates red and gray massive limestones from an overlying noncherty, or but slightly cherty, dense gray limestone, ranging up to 12 feet or more in thickness. The limestone underlies the typically developed highly cherty Reeds Spring and is commonly designated as Pierson. The conodonts from the shaly member resemble those from the succeeding lime, the Pierson, rather than those from the underlying red limestone which Branson designates as Northview (Branson, 1939). In the shale zone appear for the first time the genera *Doliognathus* and *Scaliognathus* and the first of the typical representatives of *Bactrognathus*. With them are few if any specimens of *Polygnathus communis*, a form which is very abundant in the underlying strata.

SYSTEMATIC DESCRIPTIONS

Genus SPATHOGNATHODUS
Branson and Mehl, n. name

Spathodus BRANSON and MEHL, *1933*, Univ. Missouri Studies, vol. 8, no. 1, Conodont Studies no. 1, p. 46.

The name *Spathodus* Branson and Mehl is preoccupied by *Spathodus* Boulenger, given to an African fish genus (Boulenger, 1900).

As pointed out in the original description of the genus, it seems to be the stock from which a considerable number of genera originated. At more than one stage in the history of the group there was a tendency for the migration of the navel to the posterior end of the blade. It was one such trend that almost certainly gave rise to the genus *Gnathodus* and other allied forms.

Genotype.—Spathodus primus Branson and Mehl, Univ. Missouri, C 151-5 and C 152-1.

SPATHOGNATHODUS COMMUTATUS
Branson and Mehl, n. sp.
Plate 19, figures 1–4

Axis of blade straight or slightly curved laterally. Oral edge nearly straight in its anterior half in lateral view and regularly but slightly down curved in its posterior half. Antero-aboral angle approximately 90 degrees. Blade thin anteriorly with a slight tendency to thicken posteriorly, oral edge consisting of about 16 to 20 denticles that tend to fuse, particularly in the mid-length of the blade. Navel close to the posterior end of the blade, of moderate depth, longer than wide, with pointed anterior and posterior ends, greatest transverse diameter diagonal to the blade axis, with the lesser anterior angle on the inner (concave) side of the blade.

Syntypes.—Four specimens, Univ. Missouri C 552-2.

Occurrence.—Pitkin limestone, Craig County, Okahoma.

Remarks.—This species is of special interest because of its similarity to the simpler gnathodids, differing primarily in the entire absence of nodes or ridges on the oral surface of the cup. It is likely that a comparable species of an earlier time gave rise to *Gnathodus*.

Genus BACTROGNATHUS
Branson and Mehl, n. gen.

Elongate narrow blade-like teeth with the posterior end sharply flexed into a lateral process; oral surface carinate; aboral surface with a pit at the union of the lateral process and the main blade, from which a deep groove extends forward and another laterally on the lateral process.

Genotype.—Bactrognathus hamata Branson and Mehl.

Occurrence.—Species of this genus have been found in the Welden and Sycamore of Oklahoma, the Pierson of southwestern Missouri and the Barnett shale of Texas.

Remarks.—There is such a variety among the species of this genus that it is difficult to include all of the characters in the generic analysis and at the same time exclude species of certain other genera that are only remotely related. The closest of the related genera seems to be *Doliognathus*, some species of which differ only in the development of more plate-like form.

BACTROGNATHUS HAMATA
Branson and Mehl, n. sp.
Plate 19, figures 5–8

Spathognathodid-like with main axis slightly curved laterally, concave inward, and a short postero-lateral flexure forming an antero-lateral angle of 135 degrees or more. Main plate and postero-lateral flexure

consisting of approximately 20 almost completely fused denticles of variable size, somewhat larger near the anterior end and also on the postero-lateral flexure; blade thickened near the aboral margin. Aboral side deeply excavated along the median line to form a groove that is narrow anteriorly with posteriorly diverging margins that flare into a large subcircular cup at the beginning of the postero-lateral flexure and is continued as a wide shallow trough on the process.

Holotype.—Univ. Missouri, C 25-3.

Occurrence.—Pierson limestone, Barry County, Missouri.

BACTROGNATHUS ANGULARIS
Branson and Mehl, n. sp.
Plate 19, figures 9, 18, 19

Tooth more or less blade-like with nearly straight main axis and a postero-lateral claw-like process which forms an angle of about 90 degrees with the main axis. Lateral shelves of the main piece plain on the oral surface and narrow, little more than a swollen ridge, at the base of the denticles, very gradually tapered from an anterior point to the greatest width somewhat back of midlength. Carina consisting of about 12 sharply pointed denticles that coalesce throughout much of their length, larger near the anterior end of the series with the one of largest size at the posterior end at the base of the postero-lateral process. Postero-lateral extension blade-like, consisting of about five large, laterally compressed denticles. Aboral side of plate completely traversed by a narrow deep groove with an expansion into a deep round cup of small diameter at the origin of the postero-lateral process.

Holotype.—Univ. Missouri, C 419-1.

Occurrence.— Sycamore formation, Pontotoc County, Oklahoma.

BACTROGNATHUS DISTORTA
Branson and Mehl, n. sp.
Plate 19, figures 10–11

Main part of tooth bar-like, straight, short and stout; produced orally into a thin carina consisting of about seven laterally compressed sharp-pointed and sharp-edged denticles that increase in size toward the posterior end of the series; all with confluent edges but discrete apices. Postero-lateral process stout, set off from the main piece on the oral surface by a deep sulcus, directed normal to the main axis at its union but sharply recurved beyond so that the free terminus points backward; oral surface produced into a sharp, crenulate carina consisting of about five partly coalesced, sharply pointed denticles, the larger of which are near the proximal end. Aboral surface of both the main piece and the postero-lateral process transversely rounded and traversed longitudinally by a narrow groove that expands into a moderately deep, thick-lipped circular pit at the posterior end of the main piece.

Holotype.—Univ. Missouri, C 421-1.

Occurrence.—Sycamore formation, Pontotoc County, Oklahoma.

BACTROGNATHUS EXCAVATA
Branson and Mehl, n. sp.
Plate 19, figures 12–13

Tooth with an exceptionally large angular aboral cup from the posterior side of which a postero-lateral process bends abruptly sidewise and thence curves sharply backward. Blade slightly curved laterally, concave inward, particularly at the oral edge; consisting of completely fused denticles that form an irregular oral edge that is highest near the anterior terminus. Oral surface of the remarkably expanded cup smooth except for a sharp node on the inner side close to the blade. Postero-lateral process with denticles completely fused, forming a sharp oral edge and a sharp posterior end. Aboral side of the piece traversed by a deep groove which extends forward and backward from the cup and diminishes in width on the postero-lateral process.

Holotype.—Univ. Missouri, C 418-3.

Occurrence.—Sycamore formation, Pontotoc County, Oklahoma.

BACTROGNATHUS CLAVIGER (Roundy)
Branson and Mehl

Polygnathus (?) *claviger* ROUNDY, *1926*, U. S. Geol. Survey, Prof. Paper 146, pp. 14–15, pl. IV, figs. 1a–2b.

Original description:

Seen from above, base massive, elongate, pointed at one end, broad and blunted at the other. Base smooth, with a row of large elongate teeth. Each tooth has about equally convex sides, which meet in a sharp edge or carina on the front

and rear. For purposes of description the sharp end of the base is considered the front. Individuals vary as to the relative size of the teeth and the space between them. Some are in contact in their lower third, some only at their base, and occasionally two adjacent teeth have a perceptible distance between their bases. There is also variation in the length of the teeth, the shorter ones usually being nearly straight and the longer ones curved slightly backward. This backward curve is the main reason for my considering the pointed end of the base as the anterior. In position, the row of teeth is in the center of the base at the front end, then gradually swings to one side of the base toward the broad end, where a solitary tooth occurs on the other edge opposite the last tooth of the row. These teeth so resemble in miniature the old-style farmer's spike drag that I have given them the name *P. claviger* (*clavus*, spike; *gero*, I bear). Adjacent to the above-mentioned solitary teeth, a small portion of the base is broken, so that it is possible that another tooth might originally have been present.

In side view the base seems to be about equal in thickness except at the extreme ends.

Seen from below, a pulp cavity wider than long, subrectangular in outline, is located near the posterior end, and a narrow groove extends in the center of the base nearly to the extreme front end.

Occurrence.—Barnett shale, San Saba County, Texas.

Remarks.—There is little doubt that this species belongs to the genus *Bactrognathus*, but the absence of the entire postero-lateral process in the type leaves its specific characters in doubt.

Bactrognathus inornata
Branson and Mehl, n. sp.
Plate 19, figures 14, 15

Tooth narrow, pointed, plate-like with a lateral process at the posterior end. Both main lobe and postero-lateral process gently arched, axis of both slightly curved laterally, and both parts a little twisted so as not to lie in a common plane. Lateral platforms of main lobe smooth, increasing in width gradually from the pointed anterior end, and presenting a somewhat irregular lateral outline. Carina consisting of about 10 closely spaced sharp-pointed nodes of which the front ones coalesce. The postero-lateral process is occupied by about three discrete to fused, large pointed nodes. At the junction of the carinae is a single pointed node of exceptionally large size. The postero-lateral process forms an angle of about 130 degrees with the main axis. The aboral surface is rounded rather than keeled, and a narrow sinuous groove extends along the median part of the main lobe and another along the postero-lateral process. There is a small pit where the two grooves join.

Holotype.—Univ. Missouri, C 417-4.

Occurrence.—Sycamore formation. Pontotoc County, Oklahoma.

Genus Doliognathus
Branson and Mehl, n. gen.

Elongate plate-like teeth with pointed termini; concave or flat in transverse section; oral surface carinate, with discrete or fused denticles extending the full length. Major axis straight or slightly curved near the posterior end where it turns inward. Outer side produced into a pointed carinate process which diverges from the region of the lateral flexure of the main axis. Oral surface smooth, transversely ridged or with nodose lateral margins. Aboral surface medially keeled, with a sharply outlined pit at the union of the main axis and the postero-lateral process.

Genotype.—*Doliognathus lata* Branson and Mehl.

Remarks.—There are marked changes of each species from immature to old specimens. Almost without exception the aboral surface of young individuals is deeply excavated rather than keeled so as to resemble the development in *Icriodus latericrescens*. With maturity the lateral shelves of the plate increase in width and the carina becomes less conspicuous. Mature forms of *Doliognathus* resemble most closely some of the ancyrognathids, differing chiefly in the absence or slight development of a blade and the lack of bilateral symmetry. The closest affinities of *Doliognathus* are probably among the bactrognathids.

Doliognathus lata
Branson and Mehl, n. sp.
Plate 19, figures 22–26

Broad, plate-like teeth with main part pointed anteriorly and produced into a short blade-like terminus. The postero-lateral process is about half as long as the main lobe and it diverges from the latter about one-third its length from the posterior end. Its anterior margin forms an angle of slightly more than 90 degrees with

one margin of the main lobe, and its posterior margin joins the main lobe in an obtuse angle or gentle curve. Oral surface of main lobe and process gently concave upward in transverse section and slightly arched longitudinally. A median carina, nodose rather than denticulate, high at the anterior end, traverses the main lobe to its extremities and a similar carina on the process abuts against it. Oral surface of the lateral platforms of the entire plate nearly smooth except for short marginal wrinkles or ridges normal to the margins. Aboral surface traversed by a pronounced keel with a lateral branch on the process. A faint groove along the keel expands into a pit of moderate size at the union of the main axis and the process.

Holotype.—Univ. Missouri, C 140-4.

Occurrence.—Pierson limestone, Roaring River Park, Barry County, Missouri.

DOLIOGNATHUS DUBIA
Branson and Mehl, n. sp.
Plate 19, figures 16, 17

Tooth roughly lanceolate with a sinuous axis and a distinct accessory lobe on the inner side opposite the short postero-lateral process. Lateral shelves of oral surface smooth, narrow, increasing in width from the extremities to near midlength. A strong carina consisting of partially coalesced, sharp, pointed denticles extends from one extremity to the other with little differentiation except that it is highest near the anterior end. The equidimensional lateral accessory lobe bears a centrally located node. The axis of the postero-lateral process forms an antero-lateral angle of about 135 degrees with the main axis. The aboral surface is strongly keeled in the anterior half, back of which the bounding laminae diverge to form a wide, deep pit near the posterior end and converge again to form a keel on the postero-lateral process.

Holotype.—Univ. Missouri, C 418-1.

Occurrence.—Sycamore formation, Pontotoc County, Oklahoma.

DOLIOGNATHUS EXCAVATA
Branson and Mehl, n. sp.
Plate 19, figures 20, 21

Slenderly elongate, plate-like teeth with main lobe sharply pointed anteriorly and narrowly rounded posteriorly, greatest width at about midlength. Axis straight except for a slight inward curve in the posterior third. Postero-lateral process about one-fourth as long as main lobe and about half as wide as long. It meets the main lobe near the posterior end and projects outward and slightly backward. Its sides are sub-parallel to near the pointed end. Oral surface of main lobe and process flat to slightly convex upward in transverse section and both slightly arched longitudinally; lateral shelves of both minutely granular. The carina of the main piece consists of about 14 laterally compressed, pointed semi-discrete nodes, the higher at the anterior end of the series. The carina of the process low, sharp, continuous or nodose. Aboral side of both main lobe and process traversed by a high split keel, the laminae of which diverge rapidly so as to leave an exceptionally large pit at the union of the main piece and the process.

Holotype.—Univ. Missouri, C 573-2.

Paratype.—Univ. Missouri, C 594-2.

Remarks.—This species indicates the close affinity between the genera *Doliognathus* and *Bactrognathus*. The differences between *D. excavata* and *B. dubia* are slight and consist primarily in the development of a lateral lobe in the latter rather than a distinct postero-lateral process. The chief differences between *D. excavata* and *D. lata* are the considerably greater width of the plate and the much smaller aboral pit of the latter.

Genus SCALIOGNATHUS
Branson and Mehl, n. gen.

Anchor-shaped or pick-shaped plate-like teeth with pointed termini; main axis straight or slightly curved; transverse axis straight or concave anteriorly; oral surface flat or concave in transverse cross section; median carina of discrete or partly coalesced denticles on main axis and transverse process. Aboral side keeled, with keel of main lobe not extending across the transverse keel; longitudinal and transverse keels joined in a common pit of moderate size.

Genotype.—*Scaliognathus anchoralis* Branson and Mehl.

Range.—*Scaliognathus* has been found in Missouri, Oklahoma, and in the Hartz mountains of Germany. Its stratigraphic range as

known at present is from upper lower Mississippian to middle Mississippian.

Remarks.—The free end of the long axis is directed anteriorly with the transverse process at the posterior end. Although there is gross bilateral symmetry in most forms the details produce an asymmetry in most cases. The main axis of most specimens is concave inward, and the inner and outer ends of most transverse processes differ in length, breadth, and other details. *Scaliognathus* resembles some of the ancyrodellids in gross features, but differs in that the latter has an anterior blade, and the keel of the main axis extends back of the pit.

SCALIOGNATHUS ANCHORALIS
Branson and Mehl, n. sp.
Plate 19, figures 29–32

Anchor-shaped teeth with more or less plate-like main axial lobe and transverse process. Main lobe slightly curved laterally, pointed anteriorly, width increasing posteriorly to the maximum at the union with the transverse process. Transverse process strongly and nearly symmetrically curved, concave anteriorly, termini pointed. Inner and outer anterior angles variable but nearly equal and less than 90 degrees. Oral surface variably nodose; main axis with a median row of seven to 10 laterally compressed, sharp nodes, that tend to coalesce into a carina that is highest anteriorly and projects slightly beyond the posterior border of the plate; small irregular nodes or short sharp ridges border the lateral margins of the main lobe. The transverse process has a row of six to 10 more or less isolated pointed nodes that increase in height toward the free termini of the process, and fine short sharp ridges or irregular nodes border the margins of the process. Aboral surface smooth except for a medially grooved keel on the main lobe which joins a similar keel along the middle of the transverse process. At the juncture of the two the groove is expanded into a small pit.

Holotype.—Univ. Missouri, C 22-5.

Occurrence.—Pierson limestone, Roaring River Park, Barry County, Missouri.

Genus STAUROGNATHUS
Branson and Mehl, n. gen.

Tooth made up of four bar-like lobes which form an asymmetrical cross. Oral surfaces of lobes shallowly grooved longitudinally or flat with smooth, transversely ridged or nodose lateral margins. Aboral side of each lobe longitudinally excavated, and a deep pit appears where the grooves join.

Remarks.—In most species of this genus there are obviously right and left teeth with noticable lateral curvature of the main axis. In all such cases the concave side is called the inner, and the transverse lobes are designated as the inner and outer. For purposes of description the longer end of the main piece is directed forward. The inner and outer anterior angles are those formed by the transverse process and anterior lobe.

Although *Staurognathus* is not closely related genetically to either *Ancyrognathus* or *Ancyrodella*, it has some of the general characteristics of the species of these genera. Aside from the fact that there is a considerable time gap between the last of the ancyrodellids and ancyrognathids and the first of the staurognathids, the latter group differs in that it has little tendency to develop a free blade and is never plate-like.

Genotype.—*Staurognathus cruciformis* Branson and Mehl.

Occurrence.—The age of some of the formations in which species of this genus appear is in doubt, but the earliest representatives seem to come from the late lower Mississippian. Representatives have not been found in the upper Mississippian or later formations.

STAUROGNATHUS CRUCIFORMIS
Branson and Mehl, n. sp.
Plate 19, figures 35–36

Tooth made up of four lobes each of different size than the others. Anterior lobe largest; with pointed anterior end, and nearly uniform width excepting near the terminus; flat or slightly arched dorsoventrally, curved laterally.

Transverse bars straight or very slightly concave anteriorly; stout, inner lobe about half as long as the outer. Posterior bar shortest, pointed. Outer anterior angle about 100 degrees, inner anterior angle about 80 degrees. Oral surface of all lobes faintly grooved longitudinally at midwidth; lateral margins made up of coarse nodes that form

several transverse ridges on the outer half of the main lobe. Aboral side with a deep, flaring-sided median groove on each lobe, and a large pit where the grooves meet.

Holotype.—Univ. Missouri, C 418-2.

Occurrence.—Sycamore (Mays) formation, Pontotoc County, Oklahoma.

Remarks.—This species is remarkably variable, especially in the relative length of the inner lobe and the arrangement of the nodes on the oral surface. In some specimens, the nodes are rounded and regular in size and arrangement and in others they are irregular and somewhat pointed.

Genus POLYGNATHODELLA Harlton

Polygnathodella HARLTON, *1933*, Jour. Paleontology, vol. 7, p. 15.
Idiognathoides HARRIS and HOLLINGSWORTH, *1933*, Am. Jour. Sci., vol. 25, p. 201, pl. 1, fig. 14.

Harlton's description:

Similar to *Polygnathus*, but posterior bar extends along margin of oral surface.

Harris and Hollingsworth's description:

This genus embraces anteriorly transversely ridged conodonts in which the median longitudinal, backward-plunging channel, without semblance of crest, is a prominent feature. Plate subsymmetrically lanceolate, flat to convex orally and bearing transverse ridges and often semiridges in its anterior unchanneled portion; deep, median, crestless channel extending forward from posterior end of plate and dying out at a point near the center of the plate, bordered by denticulated or corrugated rims; posterior projecting bar denticulate.

Revised description.—Platform-like teeth with antero-posteriorly elongate oral surface, flat or shallowly trenched longitudinally, with fine transverse corrugations; outer side of platform produced anteriorly into a free blade without vertical differentiation at the confluence of the blade and lateral margin; aboral side deeply excavated with lateral sides widely flared to produce a bilaterally asymmetrical cup, somewhat longer than wide, with lateral halves antero-posteriorly offset.

Orientation.—The blade rises from the *outer* side and extends *anteriorly*. The *outer half* of the cup is the wider and has its greatest transverse diameter back of that of the opposite or *inner* half.

Remarks.—There is little doubt that *Polygnathodella* and *Idiognathoides* were proposed for the same group, although Harris and Hollingsworth referred two of the more typical species to the genus *Idiognathodus* Gunnell. These authors assumed that *Polygnathodella* originated from *Cavusgnathus* by the partial filling of the median channel on the oral surface and that the complete filling produced *Idiognathodus* (1933, pp. 193–194). The latter assumption seems ill-founded as *Idiognathodus*, from its inception to the last appearance of the group, has a median blade that is not connected with the lateral margin of the plate. The first assumption may be justified although the connection between *Polygnathodella* and *Cavusgnathus* is not clear.

Range.—The genus *Polygnathodella* is of short stratigraphic range. It has not been found in extensive collections of late Mississippian conodonts from the Pitkin of Oklahoma and Arkansas, the Chester of Indiana, or the Heath of Montana, nor has it been found in any of our large number of Cherokee (lower Pennsylvanian) collections or their time equivalents.

It has been collected from the Wapanucka, the John's Valley, and the lower Dornick Hills of Oklahoma, some zones of the Hartville of Wyoming, and from the upper Quadrant of Montana.

POLYGNATHODELLA FOSSATA
Branson and Mehl, n. sp.
Plate 19, figures 27–28

Platform exceptionally high with sides vertical except near the base. Outline of oral surface veined laterally. Oral surface nearly flat, converging slightly toward the aboral side in the posterior part, outline fluted. Outline viewed orally elongate, gradually tapered to a sharp posterior point from the greatest width at about a third the distance from the anterior end, inner side straight to sinuous with a slight convexity in the anterior half and a slight concavity in the posterior half, outer side straight in the posterior half and rounded rapidly in the anterior half to the constricted anterior border; trench laterally curved with a tendency to parallel the outer margin of the platform, shallow except at the anterior end, extend-

ing posteriorly fully half the length of the platform; transverse ridges coarse, sharp-topped with deep sharp-bottomed intervening grooves, normal to the lateral margins of the platform with discontinuity at the trench except that the posterior four to six are straight and continuous. Details of blade unknown, but the oral edge of the posterior part is in about the plane of the platform. Aboral cup deep, about twice as long as wide, outer lip greatly extended laterally near the anterior end.

Holotype.—Univ. Missouri, C 60-2.

Occurrence.—Hartville formation, about 200 feet above the base, Guernsey Dam, Guernsey, Wyoming.

Polygnathodella attenuata (Harris and Hollingsworth) Branson and Mehl

Idiognathodus attenuata Harris and Hollingsworth, Am. Jour. Sci., *1933*, vol. 25, pp. 203–204, pl. 1, figs. 9a, 9b.

Harris and Hollingsworth's original description:

Tooth small, narrow, slender, elongate, anteriorly sharply pointed, inner edge of plate straight or very slightly concave, outer edge distinctly convex, strongly so around posterior corner, thus causing entire form to appear curved inwardly; plate approximately uniform in lateral height, in side view oral face flat and tending to undulate longitudinally in old age; oral face of adult traversed by fifteen or sixteen low un-

---

Explanation of Plate 19

All figures × 25 unless otherwise stated.

Figs. *1–4*—*Spathognathodus commutatus* Branson and Mehl. Oral, outer-lateral, inner-lateral, and aboral views of four syntypes (Univ. Missouri, C552-2), from the Pitkin limestone near Afton, Oklahoma. (p. 98)

5–8—*Bactrognathus hamata* Branson and Mehl. Inner-lateral, outer-lateral, aboral, and oral views of holotype (Univ. Missouri, C25-3), from the Pierson limestone of Barry County, Missouri. (p. 98)

9—*Bactrognathus angularis* Branson and Mehl. Aboral view of a specimen of this species (Univ. Missouri, C573-4) with abnormal development of the postero-lateral process. (p. 99)

10–11—*Bactrognathus distorta* Branson and Mehl. Oral and aboral views of the holotype (Univ. Missouri, C521-1), from the Sycamore formation of Pontotoc County, Oklahoma. (p. 99)

12–13—*Bactrognathus excavata* Branson and Mehl. Oral and aboral views of the holotype (Univ. Missouri, C418-3), from the Sycamore formation of Pontotoc County, Oklahoma. (p. 99)

14–15—*Bactrognathus inornata* Branson and Mehl. Oral and aboral views of the holotype (Univ. Missouri, C417-4), from the Sycamore formation of Pontotoc County, Oklahoma. (p. 100)

16–17—*Doliognathus dubia* Branson and Mehl. Aboral and oral views of the holotype (Univ. Missouri, C418-1), from the Sycamore formation of Pontotoc County, Oklahoma. (p. 101)

18–19—*Bactrognathus angularis* Branson and Mehl. Aboral and oral views of the holotype Univ. Missouri, C419-1), from the Sycamore formation of Pontotoc County, Oklahoma. (p. 99)

20–21—*Doliognathus excavata* Branson and Mehl. Aboral and oral views of the holotype (Univ. Missouri, C573-2) and oral and aboral views of a specimen from an immature individual (Univ. Missouri C594-2) from the Pierson limestone at Roaring River Park, Barry County, Missouri. (p. 101)

22–26—*Doliognathus lata* Branson and Mehl. Aboral and oral views of the holotype (Univ. Missouri, C140-4) ×17, from the Pierson limestone at Roaring River Park, Barry County, Missouri. (p. 100)

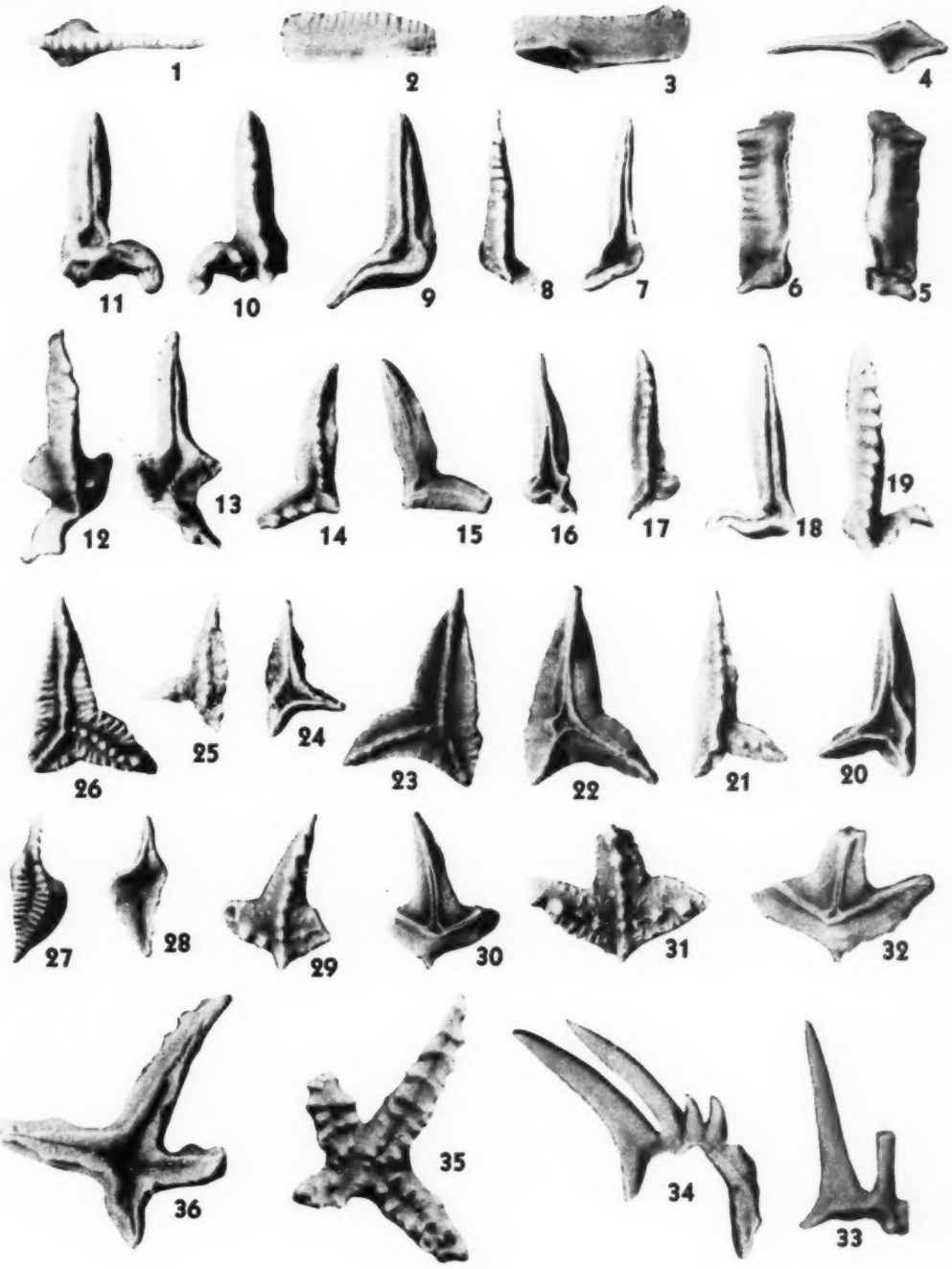
27–28—*Polygnathodella fossata* Branson and Mehl. Oral and aboral views of the holotype (Univ. Missouri, C60-2), from the Hartville formation at Guernsey Dam, Wyoming. (p. 103)

29–32—*Scaliognathus anchoralis* Branson and Mehl. *29–30*, oral and aboral views of a paratype (Univ. Missouri, C573-3); *31–32*, oral and aboral views af the holotype (Univ. Missouri C22-5), both from the Pierson limestone at Roaring River Park, Barry County, Missouri. (p. 102)

33—*Metalonchodina* sp. A specimen (Univ. Missouri, C425-2) from the Sycamore formation of Pontotoc County, Oklahoma, to show the typical offset of the bar back of the single anterior unexcavated denticle. (p. 105)

34—*Metalonchodina bidentata* (Gunnell) Branson and Mehl. Outer-lateral view of the hypotype (Univ. Missouri, CB8-10), from the top of the Lexington coal zone, Lafayette County, Missouri. (p. 106)

35–36—*Staurognathus cruciformis* Branson and Mehl. Oral and aboral views of the holotype (Univ. Missouri, C 418-2) from the Sycamore formation, Pontotoc County, Oklahoma. (p. 102)



Branson and Mehl, Carboniferous Conodonts

UNIV. OF MICH.

broken ridges, extreme posterior extremity of plate centrally channeled, the channel rims bearing six or seven denticles, the rim of outside half of plate produced posteriorly to form a thin denticulate bar.

Occurrence.—The type is recorded as from "thin arenaceous limestone at top of Cromwell member of Wapanucka formation," Pontotoc County, Oklahoma.

Remarks.—The orientation in Harris and Hollingsworth's description is the reverse of that assumed by Branson and Mehl, who examined the type and are convinced that it should be referred to *Polygnathodella*.

POLYGNATHODELLA CORRUGATA (Harris and Hollingsworth) Branson and Mehl

Idiognathodus corrugata HARRIS and HOLLINGSWORTH, *1933*, Am. Jour. Sci., vol. 25, pp. 202–203, pl. 1, fig. 7, probably not figs. 8a, 8b.

Harris and Hollingsworth's original description:

Plate flat, low, subsymmetrically lanceolate in oral view, becoming broader with age; in aboral view, deeply concave with greatest depth at posterior end of plate, in side view oral face of plate flat, becoming slipper-shaped or undulating orally in old age; plate widest immediately behind center, inner one-half of plate bending downward and inwardly posteriorly at an angle of approximately 20° to form a distinctly short, posterior channel, nine to eleven low unbroken ridges extend subparallel across anterior two-thirds of plate, the first three or four of which arch forward at the margins; on the posterior end of the inner one-half of the oral face are approximately six to eight short corrugated ribs; the posterior projecting bar is formed by the continuation of the outside one-half face of plate, it is thin, high, and coarsely denticulate.

Occurrence.—The type is recorded as coming from a thin arenaceous limestone at top of Cromwell member of Wapanucka formation, Pontotoc County, Oklahoma.

Remarks.—In the above description "anterior" and "posterior" are used in an orientation opposite that of Branson and Mehl who studied the type and are convinced that it belongs to *Polygnathodella*.

POLYGNATHODELLA SINUATA (Harris and Hollingsworth) Branson and Mehl

Idiognathoides sinuata HARRIS and HOLLINGSWORTH, Am. Jour. Sci., *1933*, vol. 25, pp. 201–202, pl. 1, fig. 14.

Harris and Hollingsworth's original description:

Tooth small, narrow, slender, acutely pointed anteriorly, concave anteriorly along margin of inside edge and posteriorly along margin of inside edge and posteriorly along margin of outside edge, the whole resulting in a sinuous outline, plate high and steep laterally, aboral face of plate channeled longitudinally with symmetrical curvature, greatest depth centrally, flanges prominent, concentrically ringed, posterior end of plate distinctly swinging downward and backward, especially noticeable along the ventral outline, anterior one-third of oral surface of plate flat and traversed by two or three short, low, transverse ridges, behind these are three or four hemitransverse ridges gently sloping inwardly and downwardly from either side, thus defining the anterior limitation of a median channel which increases in depth posteriorly, marginal rims bordering either side of the channel steeply sloping inwardly and bearing eight to 10 ill-defined denticulations, rim of outside one-half of plate high, produced posteriorly to form a thin, straight, denticulate bar.

Occurrence.—The type is recorded from the arenaceous limestone at the top of the Cromwell member of the Wapanucka formation, Pontotoc County, Oklahoma.

Remarks.—In the above description the orientation is the reverse of that assumed by Branson and Mehl except that it agrees in the assumption that the denticulate bar (blade) arises from the *outer* margin of the plate. Presumably "downward" and "ventral" refer to the aboral side. Branson and Mehl's examination of the type led them to believe that the sinuous outline described is over-emphasized.

Genus METALONCHODINA Branson and Mehl, n. gen.

Base of teeth bar-like, with one long and one short limb; strongly arched in a laterally warped plane; with straight or recurved, sharply pointed, discrete, widely spaced or closely adjacent denticles. A denticle at the summit of the arch called the apical is distinguishable by basal pit of small size. The short limb commonly supports only one denticle, longer and of greater width than those on the long limb, but it may have three or more denticles.

Remarks.—Pennsylvanian representatives of this genus have been referred commonly to *Prioniodus*, but the base of the terminal denticle in that genus contains the pit and

none of the other denticles is excavated. *Metalonchodina* seems to have originated from *Lonchodina* through the abortion of the anterior limb. Some of the Mississippian species of *Metalonchodina* retain as many as three denticles on the short limb. The lateral swing or offset of the arch at the union of the short and long limb is not evident in all species.

Genotype.—*Metalonchodina bidentata* (Gunnell) Branson and Mehl.

Range.—The precise age of some of the formations in which species of this genus occur is in doubt but the range may be stated as late lower Mississippian to Permian.

METALONCHODINA BIDENTATA
(Gunnell) Branson and Mehl
Plate 19, figure 34

Prioniodus bidentata GUNNELL, *1931*, Jour. Paleontology, vol. 5, p. 247, pl. 29, fig. 6.
Prioniodus dactylodus GUNNELL, *1933*, idem., vol. 7, p. 265, pl. 31, fig. 1.

Major limb of the tooth bent sharply down at the apex of the arch and slightly curved throughout so as to lie in the plane of the apical denticle and in line with its axis, the free end twisted so that the distal half of the aboral edge is visible in a direct lateral view. Minor limb short, occupied by one denticle. Apical denticle long, slender, slightly curved in the direction of the short limb, sharp edged, with lateral faces convex in cross-section, most conspicuously so on the outer side. Denticles of the long limb about eight, similar to the apical denticle but progressively shorter toward the end of the limb, inclined in the direction of the apical denticle and curved inward. Denticle of the short limb somewhat more robust than the apical denticle and much longer, extended anteriorly in a point at its base, sharp edged with the outer face flat to concave transversely near the base, and inner face produced inward at the base. Aboral edge flat to slightly rounded, traversed by a faint median groove which expands into a small round pit beneath the apical denticle.

Holotype.—Univ. Missouri C 485-1 (Gunnell Collection).

Hypotype.—Univ. Missouri C B 8-10

Occurrence.—The species ranges throughout the Des Moines series of the Pennsylvanian.

POLYGNATHODELLA OUACHITENSIS
Harlton

Polygnathodella ouachitense HARLTON, *1933*, Jour. Paleontology, vol. 7, p. 15, pl. 4, figs. 14b, 14c, probably not fig. 14a.

Harlton's description (parentheses by Branson and Mehl):

Plate lanceolate in outline, posterior bar (blade at the anterior end) with denticles, oral surface with transversed distinct carinae (ridges); posterior (anterior) bar (blade) connected with upper (outer) margin of oral surface. The carinae (transverse ridges) of the lower (inner) oral surface coincide with the upper ones (those of the outer half), posteriorly it has the tendency to incurve.

Remarks.—The import of the last phrase in the above description is not evident. Branson and Mehl have not examined the holotype (U. S. Nat. Mus. No. 85531) but assume that it is the specimen figured in 14b and 14c of the original publication. Figure 14a appears to be a representative of another genus.

REFERENCES

BOULENGER, G. A., *1900*, *Annales du Musée du Congo*, vol. 1, f. 6, p. 152.
BRANSON, E. B., *1939*, Stratigraphy and paleontology of the Lower Mississippian of Missouri: *University of Missouri Studies*, vol. 13, pt. 2, p. 6.
HARRIS, R. W., and HOLLINGSWORTH, R. V., *1933*, New Pennsylvanian conodonts from Oklahoma: *Am. Jour. Sci.*, 5th ser., vol. 25, pp. 193–204.
HYATT, DON L., *1936*, Preliminary report on the Fitts pool, Pontotoc County, Oklahoma: *Am. Assoc. Petroleum Geologists Bull.*, vol. 20, pp. 931–974.

MANUSCRIPT RECEIVED BY THE EDITOR AUGUST 8, 1940.

JOURNAL OF PALEONTOLOGY, VOL. 15, NO. 2, PP. 107–143, PLS. 20–23, 4 TEXT FIGS., MARCH, 1941

REVISION OF THE PENNSYLVANIAN CONODONTS[1]

SAMUEL ELLISON
Missouri School of Mines and Metallurgy, Rolla, Missouri

ABSTRACT—Fifteen genera and 50 species, 20 species of which are new, are recognized as making up the Pennsylvanian conodont fauna of Missouri and Kansas. Recent collections from each of 26 cyclothems, ranging in age from the upper Cherokee shale to the top of the Virgil series, form the basis for a revision of Gunnell's, and Stauffer and Plummer's works on Pennsylvanian conodonts. Accompanying charts show in detail the stratigraphic distribution of species.

GIRTY (1915) was the first to mention Pennsylvanian conodonts in Missouri and Kansas, previous to the description of some Coal Measures conodonts by Gunnell (1931). Gunnell's paper was followed by the description of 60 species from the Pennsylvanian shales of Texas by Stauffer and Plummer (1932). Phosphoria (Permian?) conodonts were found in Wyoming by C. C. Branson (1932), and Gunnell (1933) enlarged his own earlier work by describing 96 new species from the Pennsylvanian shales of Missouri and Kansas. Harris and Hollingsworth (1933) described a few forms from the Pennsylvanian shales of Oklahoma, and Harlton (1933) described a fauna from the Johns Valley shale of Oklahoma.

A list of conodonts from the Cherokee (Pennsylvanian) shale was presented by Bailey (1935), and conodont assemblages were reported by Jones (1935) from the Nowata (Pennsylvanian) shale of Oklahoma. Jones later (1939) reported new conodonts from the Seminole formation of Oklahoma.

In the work on classification of Pennsylvanian rocks of Kansas by Moore (1929 to 1936), there has been frequent mention of conodont-bearing shale zones. Branson and Mehl's collections from wide areas and ranging throughout the Pennsylvanian have indicated roughly the general distribution of Pennsylvanian conodonts. However, no work on these collections by Branson and Mehl has been published.

My recent collections from the Des Moines, Missouri, and Virgil series form the basis of this paper. Collections by C. C. Branson from the Big Blue series of Kansas and Gunnell's type specimens, now in the collections of the University of Missouri, have been studied. Specimens figured in the thesis work at the University of Missouri by Burnley (1938) and Ellison (1938) were available, and the large collections by Branson and Mehl from zones throughout the Paleozoic were at my disposal for comparison.

Gunnell (1931, 1933) and Stauffer and Plummer (1932), the pioneers in the field of Pennsylvanian conodonts, possessed, in all, only a few hundred specimens. Now, thousands of specimens are known from each conodont-producing zone in the Pennsylvanian of Missouri and Kansas. After examination of these thousands of specimens, it appears that many of the minute differences, so ably described by Gunnell and Stauffer and Plummer, are not of specific value. This has resulted in synonomy lists of unusual length. However, where a specific name has been suppressed, hundreds of specimens have been observed and the available types studied. All of Gunnell's types were examined but the types of Stauffer and Plummer's work were not examined. Stauffer and Plummer's descriptions and drawings are sufficiently accurate to permit some revision without examination of the types.

Inasmuch as the names of geological units are merely tools, no attempt is made here to further any particular scheme of stratigraphic classification for Missouri and Kansas. Moore's classification is used as a matter of convenience and clearness but with the understanding that a controversy exists concerning the stratigraphic nomenclature of Missouri and that of Kansas.

[1] Submitted to the Graduate Faculty of the University of Missouri in May, 1940, as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

Information of the stratigraphic distribution of species was obtained mainly from my own collections but samples collected by W. C. Warner, Gertrude Burnley, C. C. Branson, J. D. Davies, John Roberts, E. B. Branson, and M. G. Mehl were included for the sake of completeness.

conodonts, like other Pennsylvanian organic remains, are so long ranging that they have little value in separating one part of the Pennsylvanian from another. It is found from this study that, like conodonts of Mississippian and Devonian ages, the platform types serve as the best zone markers

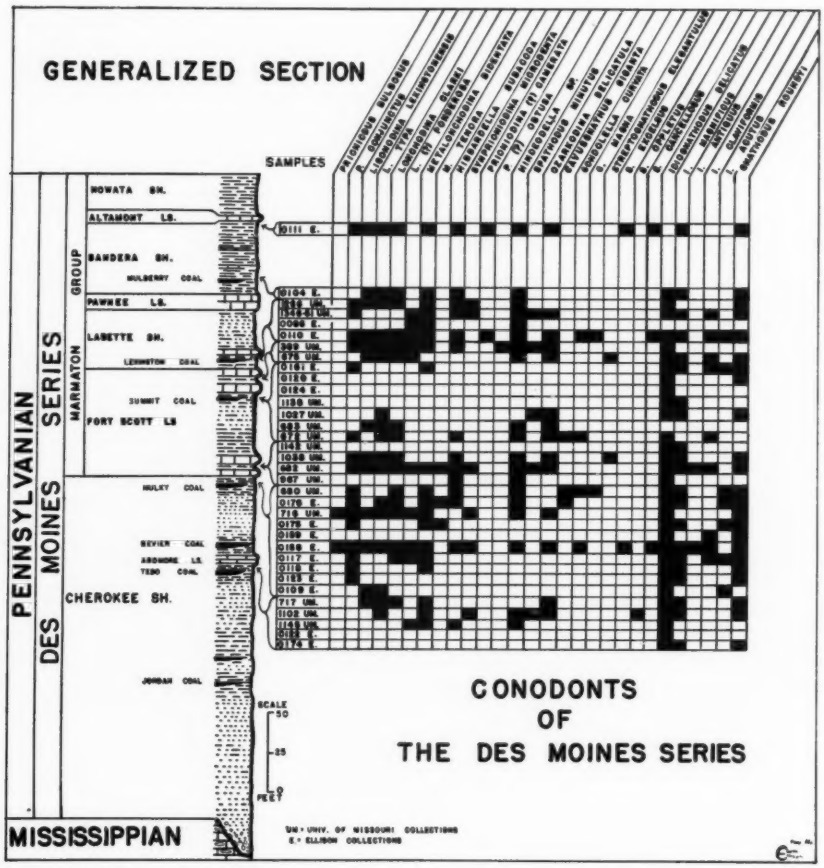


FIG. 1.—Distribution of conodont species in the Des Moines series.

I am deeply indebted to Dr. M. G. Mehl for many hours spent in the guidance of this work. Special thanks are due to Dr. E. B. Branson for reading and criticizing the manuscript. Miss Dorothy Cannady typed the manuscript.

DISCUSSION OF FAUNAS

It is not surprising to find that most of the genera and species of Pennsylvanian in the Pennsylvanian. The accompanying text figures show the long ranging character of most bar-like and blade-like forms and the vertical restriction of many platform types.

Des Moines fauna.—Although not diagnostic, the most important feature of the Des Moines fauna is the presence of great quantities of idiognathodids. However, *Idiognathodus acutus* seems to be the only spe-

cies of that genus which is confined to the Des Moines. *Gnathodus and Metalonchodina* probably rank next in abundance and are not found above the Des Moines. Although gondolellids are not commonly found in these beds, *Gondolella curvata* and *Gondolella magna* are characteristic of several zones at the base of and in the Marmaton group. Streptognathodids are poorly represented, and only one species of *Cavusgnathus* is recognized. *Prioniodus, Ligonodina, Lonchodina, Hibbardella, Prioniodina, Synprioniodina, Ozarkodina, Spathodus,* and *Hindeodella* are all represented in the Des Moines, and the species of these genera differ very little from the species of the same genera in the remainder of the Pennsylvanian.

Little is known concerning the conodonts either of the upper Mississippian or of the beds of questionable age variously referred to the Mississippian or the Pennsylvanian. The presence of *Idiognathodus, Streptognathodus,* and *Gondolella* seem to indicate Pennsylvanian age, although there is some question about the early history of *Streptognathodus. Cavusgnathus, Gnathodus,* and *Metalonchodina* occur in late Mississippian as well as in the Pennsylvanian but some of the species appear to have a more restricted range.

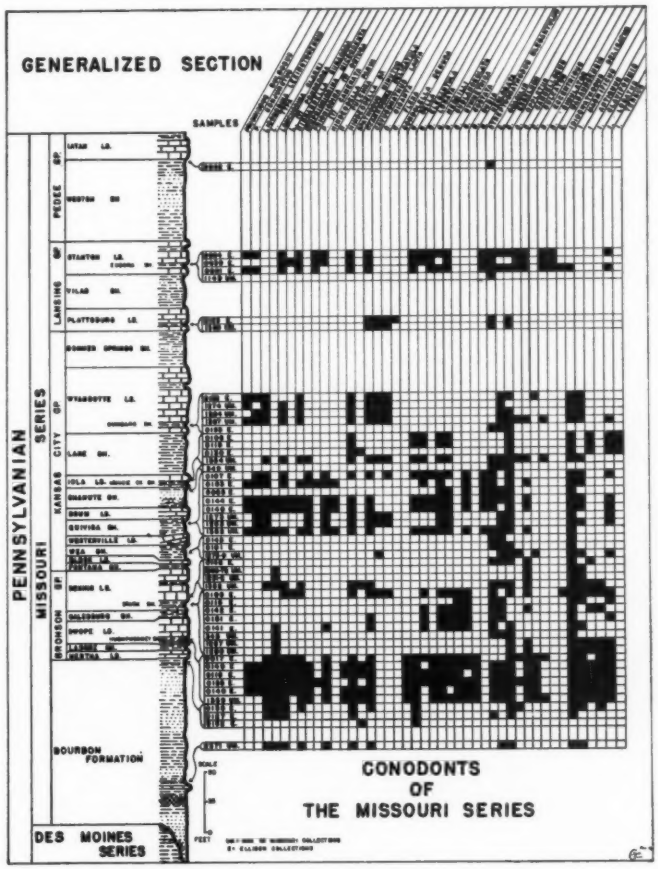


FIG. 2.—Distribution of conodont species in the Missouri series.

Missouri fauna.—Beyond a doubt, the most striking feature of the Missouri fauna is the abundance of idiognathodids, streptognathodids, and gondolellids. *Idiognathodus*

lobatus, *Streptognathodus sulcatus*, *S. eccentricus*, and *S. oppletus* are confined to the Missouri beds. *S. gracilis* and *S. wabaunsensis* appear low in the Missouri series and continue into the Virgil. *Idiognathodus tersus* appears higher and passes into the Virgil. *Streptognathodus simulator* is known from the Hushpuckney shale. *G. dubia* is confined to the Hushpuckney shale and *G. symmetrica* is known from both the Hushpuckney and Stark shales. With the exception of *G. elegantula*, which reappears in the Virgil beds, all gondolellids not mentioned above or cited in the discussion of the Des Moines

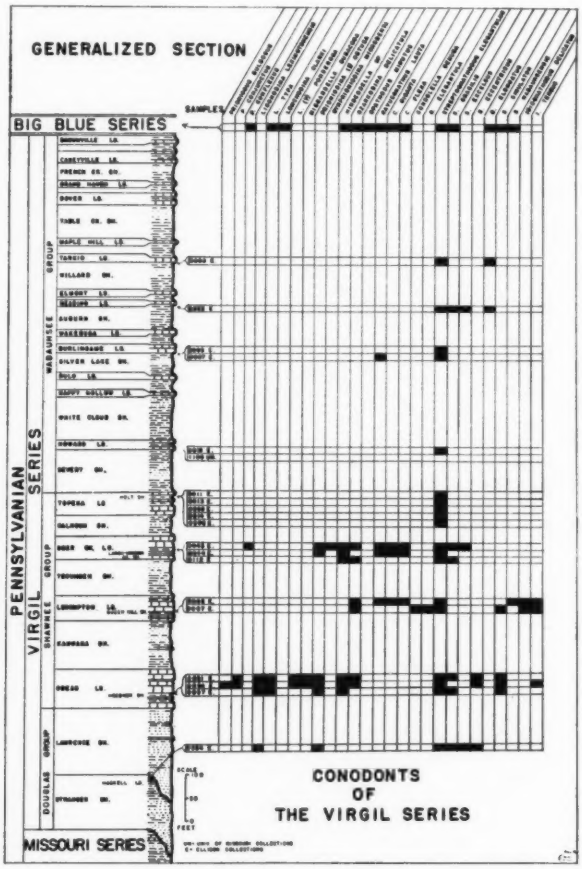


FIG. 3.—Distribution of conodont species in the Virgil series.

the Eudora shale of the Missouri beds and appears again in the Heebner shale of the Virgil. It then disappears except for a rare occurrence in the Big Blue beds. There is a noticeable disappearance of idiognathodids near the top of the Missouri series and only *I. delicatus* and *I. tersus* occur in the Virgil.

Except for one occurrence in the Virgil beds, *Gondolella denuda* is characteristic of fauna are confined to the Missouri beds.

Two species of *Cavusgnathus* are added to the Missouri fauna and these two carry on into the Virgil. The short vertical range of each of the two species of *Hindeodella* may be the result of the scarcity of complete specimens. It is possible that they occur in other zones.

Virgil fauna.—Streptognathodids consistently make up over 85 per cent of the

specimens in each sample from the Virgil series. In many cases most of these specimens belong to *Streptognathodus elegantulus*, the simple, deep-troughed form with no accessory lobes. All idiognathodids have disappeared except *Idiognathodus delicatus*, and *I. tersus*. *Streptognathodus wabaunsensis* of two species of *Prioniodus* and one species each of *Ligonodina*, *Prioniodina*, *Synprioniodina*, *Lonchodina*, and *Hibbardella* in the middle part of the Shawnee group. *Cavusgnathus*, *Ozarkodina*, *Hindeodella*, and one species each of *Ligonodina* and *Lonchodina* survive through the Virgil into the Big Blue.

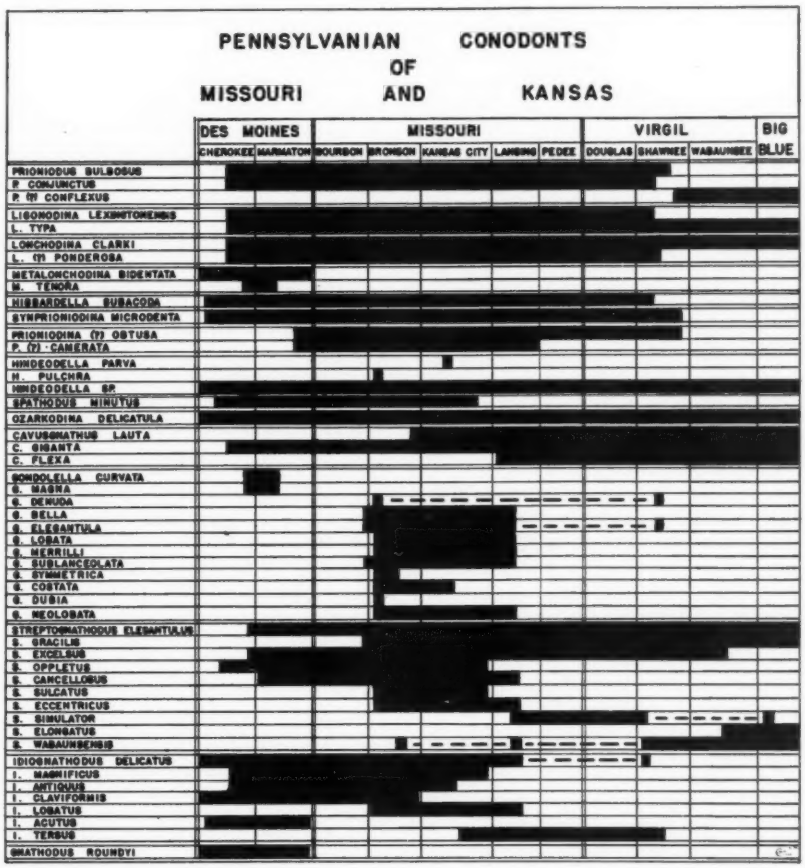


FIG. 4.—Distribution of conodont species in the Pennsylvanian.

is well established and *S. elongatus* first appears in the upper Wabaunsee beds. These last named streptognathodids carry over into the Big Blue series.

Gondolellids have disappeared except *Gondolella denuda* and *G. elegantula*, which occur in several rare instances in the lower part of the Virgil. *Prioniodus ? conflexus* is introduced in the upper Virgil and continues into the Big Blue. There is a disappearance The few forms present in the Wabaunsee group carry over into the Big Blue without change. More detailed study of the Big Blue faunas may show greater differences between the Virgil and Big Blue than are indicated.

Gunnell's (1931, 1933) figured specimens, now at the University of Missouri, bear University of Missouri specimen numbers and are indicated by (G) in the text. Holo-

type specimens are now designated for Gunnell's valid species. He did not designate holotypes. Specimens listed from Burnley's (1938) thesis at the University of Missouri have University of Missouri specimen numbers and are indicated by (B). All figured specimens are deposited in the University of Missouri collections.

EXPLANATION OF PLATE 20

(All figures 28×)

FIGS. *1–3, 16—Prioniodus conjunctus* Gunnell. *1–3*, Aboral and two lateral views, Quivira shale. (Sample 1362 U. M.; specimen, Univ. Missouri C554-1). *16*, Lateral view of senile specimen, Cherokee shale. (Sample 0017 E.; specimen, Univ. Missouri C136-1). (p. 113)

4–7—Prioniodus bulbosus Ellison, n. sp. *4*, Lateral view, Larsh-Mission Creek shale. (Sample 0043 E.; specimen, Univ. Missouri C142-1), *5–7*, Aboral and two lateral views of holotype, Quivira shale. (Sample 0107 E.; specimen, Univ. Missouri (C554-2). (p. 114)

8–11—Ligonodina typa (Gunnell). Aboral and three lateral views, Quivira shale. (Sample 0107 E.; specimens, Univ. Missouri C554-4 and C140-5). (p. 114)

12, 17—Prioniodina ? obtusa Ellison, n. sp. *12*, Lateral view of holotype, Heebner shale. (Sample 0081 E.; specimen, Univ. Missouri C138-5). *17*, Lateral view, Quivira shale. (Sample 0107 E.; specimen, Univ. Missouri C131-4). (p. 119)

13–15—Ligonodina lexingtonensis (Gunnell). Aboral and two lateral views, Quivira shale. (Sample 1362 U. M.; specimen, Univ. Missouri C554-5). (p. 115)

18, 19, 23, 24, 32, 33—Hindeodella sp. *18*, Lateral view of posterior terminus, Quivira shale. (Sample 0107 E.; specimen, Univ. Missouri C131-3). *19*, Lateral view of posterior terminus, Quivira shale. (Sample 0107 E.; specimen, Univ. Missouri C131-1). *23, 24, 32, 33*, Lateral views of bar segments and anterior termini, Hushpuckney shale. (Sample 0107 E.; specimens, Univ. Missouri C129-3 and C555-4). (p. 118)

20—Hindeodella pulchra Ellison, n. sp. Lateral view of holotype, Hushpuckney shale. (Sample 1359 U. M.; specimen, Univ. Missouri C555-2). (p. 117)

21, 27, 30, 31—Lonchodina clarki (Gunnell). *21, 27, 31*, Aboral and two lateral views, Quivira shale. (Sample 1362 U. M.,; specimen, Univ. Missouri C555-1). *31*, Lateral view, Hushpuckney shale. (Sample 0017 E.; Specimen, Univ. Missouri C127-1). (p. 116)

22, 26—Hibbardella subacoda (Gunnell). Aboral and lateral views, Quivira shale. (Sample 1362 U. M.; specimen, Univ. Missouri C554-3). (p. 118)

25—Prioniodus ? conflexus Ellison, n. sp. Lateral view of holotype, Hughes Creek shale. (Sample 0028 E.; specimen, Univ. Missouri (C128-1). (p. 114)

28—Indeterminable specimen, lateral view of denticulate bar, Heebner shale. (Sample 0081 E.; specimen, Univ. Missour C129-5). (p. 138)

29—Hindeodella parva Ellison, n. sp. Lateral view of holotype, Quivira shale. (Sample 1362 U. M.; specimen, Univ. Missouri C555-3). (p. 117)

34—Metalonchodina tenora Ellison, n. sp. Lateral view of holotype, Cherokee shale. (Sample 0175 E.; specimen, Univ. Missouri C99-5).

35, 36—Metalonchodina bidentata (Gunnell). Lateral views, Cherokee shale. (Sample 0110 E.; specimens, Univ. Missouri C99-3 and C99-4). (p. 117)

37–39—Lonchodina ? ponderosa Ellison, n. sp. *37, 39*, Lateral views, Hushpuckney shale. (Sample 0017 E.; specimen, Univ. Missouri C99-2 and C87-5). *38*, Lateral view of holotype, Lexington coal zone. (Sample 0110 E.; specimen, Univ. Missouri C90-4). (p. 116)

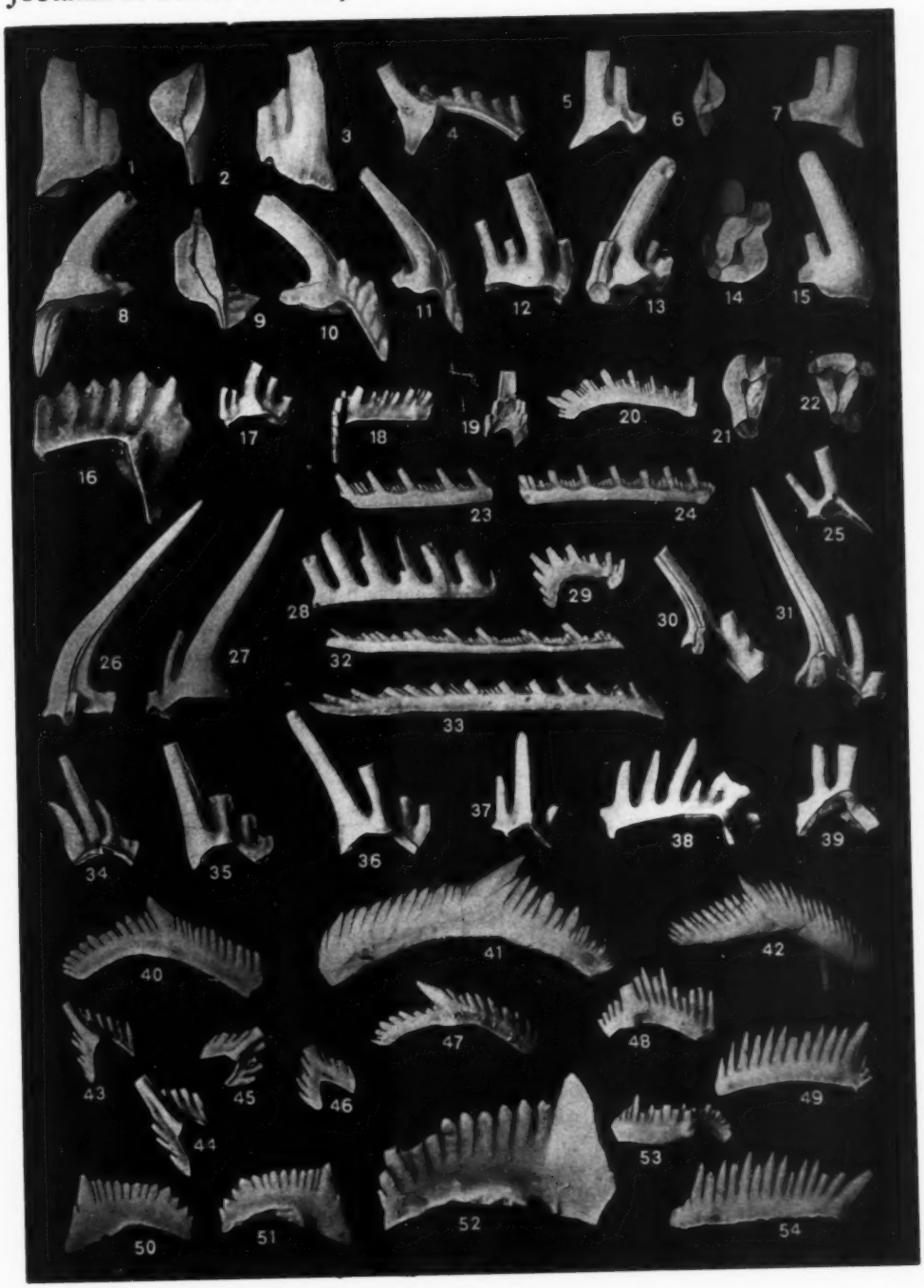
40–42, 47—Ozarkodina delicatula (Stauffer and Plummer). *40*, Lateral view, Hushpuckney shale. (Sample 0017 E.; specimen, Univ. Missouri C556–3). *41–42*, Lateral views, Lexington coal zone. (*Photographed by Burnley*) (Sample 1346–51 U. M.; specimens Univ. Missouri C-B9-7 and C-B9-2). *47*, Lateral view, Larsh-Mission Creek shale. (Sample 0043 E.; specimen, Univ. Missouri C85-4). (p. 120)

43–46—Synprioniodina microdenta Ellison, n. sp. *43, 44*, Lateral views, Hushpuckney shale. (Sample 0017 E.; specimen, Univ. Missouri C81-5 and C79-3). *45, 46*, Two lateral views of holotype, Hushpuckney shale. (Sample 1362 U. M.; specimen, Univ. Missouri C556–1). (p. 119)

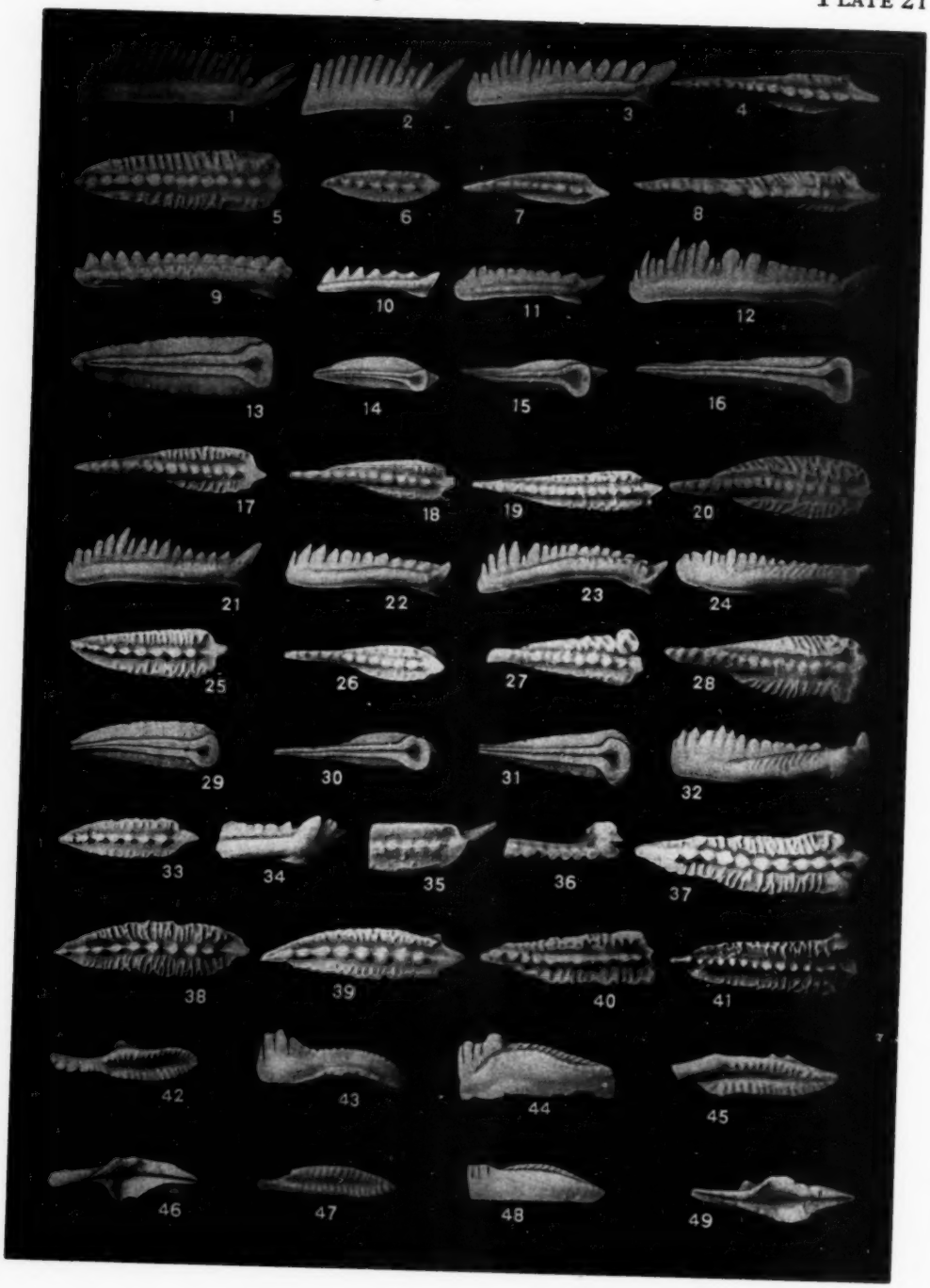
48, 49, 53—Prioniodina ? camerata (Stauffer and Plummer). *48*, Lateral view, Quivira shale. (Sample 0107 E.; specimen, Univ. Missouri C77-4). *49*, Lateral view, Hushpuckney shale. (Sample 0017 E.; specimen, Univ. Missouri C555–5). *53*, Lateral view of pathological specimen, Quivira shale. (Sample 0107 E.; specimen, Univ. Missouri C78-4). (p. 118)

50–52—Spathodus minutus Ellison, n. sp. *50, 51*, Two lateral views of holotype, Winterset limestone. (Sample 1352 U. M.; specimen, Univ. Missouri C556-2). *52*. Lateral view, Lexington coal zone. (*Photographed by Burnley*) (Sample 1346–51 U. M.; specimen, Univ. Missouri C566-1). (p. 120)

54—Gondolella denuda Ellison, n. sp. Lateral view of holotype, Hushpuckney shale. (Sample 0017 E.; specimen, Univ. Missouri C557-1). (p. 121)



Ellison, Pennsylvanian Conodonts



Ellison, Pennsylvanian Conodonts

SYSTEMATIC DESCRIPTIONS

Genus PRIONIODUS Pander, 1856

The superior fang or cusp is the large terminal denticle. It projects aborally as the anticusp. The posterior, denticle-bearing process is called the bar. For purposes of description the superior fang and attachment scar are oriented so as to be near the anterior end. The concave side of the laterally curved longitudinal axis of the bar is inward.

PRIONIODUS CONJUNCTUS Gunnell

Plate 20, figures 1–3, 16

Prioniodus conjunctus GUNNELL, *1931*, Jour. Paleontology, vol. 5, p. 247, pl. 29, fig. 7.

Prioniodus cacti GUNNELL, *1933*, Jour. Paleontology, vol. 7, p. 276, pl. 31, figs. 4, 5.

Prioniodus sp. GUNNELL, *1933*, idem, p. 267, pl. 32, fig. 32.

Bar blade-like, thin, slightly curved laterally, concave inward, aboral margin slightly arched in direct lateral view; bar denticles, four or more, laterally compressed, almost completely coalesced, decreasing in height posteriorly, slightly concave inward in vertical cross-section, and confluent with posterior edge of superior fang; fang greatly extended antero-posteriorly at the base, laterally compressed with sharp fore and aft edges, outer face slightly convex in cross section, inner face strongly

---

EXPLANATION OF PLATE 21

(All figures 28×)

FIGS. *1, 2, 36—Gondolella denuda* Ellison, n. sp. *1, 2*, Lateral views, Hushpuckney shale. (Sample 0017 E.; specimens, Univ. Missouri C184-4 and C170-5). *36*, Oral view of pathological specimens, Hushpuckney shale. (Sample 0155 E.; specimen, Univ. Missouri C169-2). (p. 121)

3, 4, 17, 21, 26, 30—Gondolella symmetrica Ellison, n. sp. *3, 4*, Lateral and oral views, Hushpuckney shale. (Sample 0155 E.; specimen, Univ. Missouri C170-4). *17, 21*, Oral and lateral views of holotype, Hushpuckney shale. (Sample 0017 E.; specimen, Univ. Missouri C558-2). *26, 30*, Oral and aboral views, Hushpuckney shale. (Sample 0017 E.; specimen, Univ. Missouri C558-1). (p. 122)

5, 9, 13, 40—Gondolella merrilli Gunnell. *5, 9, 13*, Oral, lateral, and aboral views, Quivira shale. (Sample 1362 U. M.; specimen, Univ. Missouri C557-5). *40*, Oral view, Quivira shale (Sample 0107 E.; specimen, Univ. Missouri C159-3). (p. 123)

6, 10, 14—Gondolella bella Stauffer and Plummer. Oral, lateral, and aboral views, Bourbon formation. (Sample 0162 E.; specimen, Univ. Missouri C557-2). (p. 121)

7, 11, 15—Gondolella elegantula Stauffer and Plummer. Oral, lateral, and aboral views, Quivira shale. (Sample 1362 U. M.; specimen, Univ. Missouri C557-4). (p. 121)

8, 12, 16—Gondolella dubia Ellison, n. sp. Oral, lateral, and aboral views of holotype, Hushpuckney shale. (Sample 1357 U. M.; specimen, Univ. Missouri C559-1). (p. 124)

18, 19, 22, 23, 34, 35—Gondolella sublanceolata Gunnell. *18, 22*, Oral and lateral views, Quivira shale. (Sample 1362 U. M.; specimen, Univ. Missouri C557-3). *19, 23*, Oral and lateral views, Quivira shale. (Sample 0107 E.; specimen, Univ. Missouri C558-3). *34, 35*, Lateral and oral views of a pathological specimen, Quivira shale. (Sample 0107 E.; specimen, Univ. Missouri C169-3) (p. 122)

20, 24—Gondolella costata Ellison, n. sp. Oral and lateral view of holotype, Quivira shale. (Sample 1362 U. M.; specimen, Univ. Missouri C559-2) (p. 124)

25, 29, 33, 38, 39—Gondolella curvata Stauffer and Plummer. *25, 29*, Oral and aboral views, Lexington coal zone. (Sample 0110 E.; specimen, Univ. Missouri C169-5). *33, 38, 39*, Three oral views, Lexington coal zone. (Sample 0110 E.; specimens, Univ. Missouri C169-4, C159-4 to 5). (p. 123)

27, 31, 41—Gondolella lobata Ellison, n. sp. *27, 31*, Oral and aboral views of holotype, Quivira shale. (Sample 0107 E.; specimen, Univ. Missouri C558-4). *41*, Oral view, Quivira shale. (Sample 0107 E.; specimen, Univ. Missouri C144-5). (p. 125)

28, 32—Gondolella neolobata Ellison, n. sp. Oral and lateral views of holotype, Quivira shale. (Sample 1362 U. M.; specimen, Univ. Missouri C558-5). (p. 125)

37—Gondolella magna Stauffer and Plummer. Oral view, Lexington coal zone. (Sample 0110 E.; specimen, Univ. Missouri C169-1). (p. 124)

42, 43, 46—Cavusgnathus flexa Ellison, n. sp. Oral, lateral, and aboral views of holotype, Larsh-Mission Creek shale. (Sample 0043 E.; specimen, Univ. Missouri C144-2). (p. 126)

44, 45, 49—Cavusgnathus giganta Gunnell. Lateral and oral view, Quindaro shale. (Sample 1367 U. M.; specimen, Univ. Missouri C556-4). *49*, Aboral view, Larsh-Mission Creek shale. (Sample 0043 E.; specimen, Univ. Missouri C143-4). (p. 126)

47, 48—Cavusgnathus lauta Gunnell. Oral and lateral views, Quindaro shale. (Sample 1367 U. M.; specimen, Univ. Missouri C556-5). (p. 126)

convex, anterior edge nearly straight; anticusp plow-shaped, strongly extended below general aboral outline, widely expanded on inner side into a flaring apron, anterior edge of many specimens show germ denticles in transmitted light.

Cavity beneath the fang shallow, subtriangular with one apex of the triangle directed to the inner side, surface marked by fine concentric growth lines, traversed by a longitudinal groove continued posteriorly along the aboral edge of bar.

Types.—Holotype, Univ. of Missouri C485-2 (G). Hypotypes, C554-1 (figured), C136-1 (figured), C490-1 to 2 (G), C509-5 (G), and C562-1 to 2 (B).

Remarks.—This species differs from *Prioniodus bulbosus* in that the latter has discrete denticles and the outline of the vertical section of the denticles is more concave inward. This species resembles *P. confluens* Branson and Mehl of the Grassy Creek shale but the latter has a longer anticusp.

Occurrence.—*Prioniodus conjunctus* is very common in the Des Moines and Missouri series. The Heebner shale (Oread limestone) produces the species from the Virgil series.

PRIONIODUS BULBOSUS Ellison n. sp.
Plate 20, figures 4–7

Bar blade-like, thin, slightly curved laterally, concave inward, aboral margin slightly arched in direct lateral view; bar denticles, five or more, discrete, laterally compressed, subelliptical in cross-section, decreasing in height posteriorly, and strongly concave inward in vertical cross-section; fang greatly extended antero-posteriorly at the base, laterally compressed with sharp fore and aft edges, outer face slightly convex in cross-section, inner face strongly convex, anterior edge nearly straight; anticusp plow-shaped, strongly extended below general aboral outline, widely expanded on inner side into a bulbose flaring apron, anterior edge with germ denticles or small sharp pointed denticles.

Cavity beneath the fang, shallow, subtriangular, with one apex of the triangle directed to the inner side, surface marked by fine concentric growth lines, traversed by a longitudinal groove continued posteriorly along the aboral edge of bar.

Types.—Holotype, Univ. of Missouri C554-2 (figured). Paratype, C142-1 (figured).

Remarks.—This species is smaller than *Prioniodus conjunctus* and is distinguished by its discrete denticles, bulbose apron, and strong inward curvature of denticles. *P. peculiaris* Branson and Mehl of the Bushberg sandstone resembles this species but has a marked posterior curvature of the denticles.

Occurrence.—*Prioniodus bulbosus* is known from the Cherokee shale to the Larsh-Mission Creek shale (Deer Creek limestone).

PRIONIODUS ? CONFLEXUS Ellison n. sp.
Plate 20, figure 25

Euprioniodina ? sp. GUNNELL, *1933*, Jour. Paleontology, vol. 7, p. 269, pl. 33, fig. 24.

Large terminal fang, laterally compressed, sharp-edged, strongly concave inward in vertical section, slightly convex cross-section on outer face, inner face strongly convex; base of fang expanded antero-posteriorly into a long, slender, pick-shaped anticusp, widely expanded on inner side into flaring apron; posterior bar thin, bearing one or two discrete laterally compressed inwardly curved denticles; attachment scar, bearing a pit beneath fang, shallow, expanded into a sublanceolate cup, anteriorly pointed, traversed by a longitudinal groove that is continued posteriorly along the aboral edge of bar.

Holotype.—Univ. of Missouri C128-1 (figured).

Remarks.—*Prioniodus ? conflexus* departs from typical prioniodids in that a wide aboral groove is present. The form may be a lonchodinid which has been highly modified.

Occurrence.—*Prioniodus ? conflexus* is known from the Larsh-Mission Creek shale (Deer Creek limestone) and the Hughes Creek shale (Big Blue series).

Genus LIGONODINA Ulrich and Bassler, 1926

For purposes of description the superior cusp and aboral cavity are oriented so as to be near the anterior end. The side of the cusp bearing the laterally and aborally directed limb is designated the inner side.

LIGONODINA TYPA (Gunnell)
Plate 20, figures 8–11

Idioprioniodus typus GUNNELL, *1933*, Jour. Paleontology, vol. 7, p. 265, pl. 31, fig. 47.

Prioniodus ? galesburgensis GUNNELL, *1933*, idem, p. 267, pl. 31, fig. 12.

Superior fang long, pointed, recurved, sharpest curvature near the base, subcircular in cross-section near the base, compressed in upper portion to a sharp pointed lenticular cross-section outline, long axis of which is directed inward and anteriorly, inner sharp edge forming the anterior margin of a groove that extends from near midlength to base of cusp; a groove outlined in a similar way on the outer posterior surface of fang; base of cusp expanded uniformly into a flaring apron on all sides; posterior limb, length unknown, bearing laterally compressed, recurved, sharp-edged, pointed, discrete denticles; lateral limb projected aborad-inward in a plane at approximately right angles to the posterior bar, which is short and bears five to eight antero-posteriorly compressed, sharp-edged, pointed, denticles discrete for over one-half their length.

Aboral cavity shallow, subelliptical in outline, marked by fine concentric growth lines, anterior portion regularly rounded, deep pit beneath superior cusp, traversed by a groove extended along the aboral edge of the two limbs.

Types.—Holotype, Univ. of Missouri C498-5 (G). Hypotypes, C554-4 (figured), C140-5 (figured), C491-4 (G), and C563-1 to 2 (B).

Remarks.—This species differs from *Ligonodina lexingtonensis* in that the angle between the anterior and posterior limbs of the latter forms an obtuse angle and not a right angle. *L. lexingtonensis* also has a shovel-like apron on the inner side of the base of the cusp.

Occurrence.—Ligonodina typa is found from the Cherokee shale to the beds of the Big Blue series. It is very abundant in the Des Moines and Missouri series.

LIGONODINA LEXINGTONENSIS (Gunnell)
Plate 20, figures 13–15

Prioniodus lexingtonensis GUNNELL, *1931*, Jour. Paleontology, vol. 5, p. 246, pl. 29, fig. 4.
Prioniodus tridentatus GUNNELL, *1931*, idem., p. 246, pl. 29, fig. 3; STAUFFER AND PLUMMER, *1932*, Univ. Texas Bull., 3201, p. 28, pl. 3, figs. 24–26.
Idioprioniodus camerus GUNNELL, *1933*, Jour. Paleontology, vol. 7, p. 265, pl. 32, fig. 30.
Euprioniodina ? sp. GUNNELL, *1933*, idem., p. 269, pl. 33, fig. 6.

Superior cusp long, pointed, recurved, sharpest curvature near the base, subcircular in cross-section near the base, compressed in upper portion to a sharp pointed lenticular cross-section outline, long axis of which is directed inward and anteriorly, inner sharp edge forming the anterior margin of a groove that extends from near midlength to base of cusp; a similar groove outlined on the outer posterior surface of fang; base of cusp expanded into a flaring plow-like apron on the inner posterior side; outer side smooth and not prominently expanded; posterior limb, length unknown, bearing laterally compressed, recurved sharp edged, pointed, discrete denticles; lateral limb projected aborad-inward and slightly anteriorly in a plane forming an obtuse angle with the plane of superior cusp; lateral limb bearing five to eight antero-posteriorly compressed, sharp-edged, pointed, denticles discrete for over one-half their length.

Aboral cavity shallow, subelliptical in outline, marked by fine concentric growth lines and a deep median pit, anterior portion regularly rounded, traversed by a groove extended along the aboral edge of the two limbs.

Types.—Holotype, Univ. of Missouri C484-4 (G). Hypotypes, C554-5 (figured), C484-3 (G), C509-3 (G), and C515-4 (G).

Remarks.—This species is distinguished by its almost circular aboral attachment scar, the shovel-like apron on the inner side of the base of the cusp, and the obtuse angle formed by the union of the posterior and lateral limbs. *Ligonodina typa* possesses a lateral limb that joins the posterior limb at right angles and it lacks the shovel-like apron on the inner side of the base of the cusp. The specific name *tridentata* cannot be used here because it is preoccupied by a Devonian form described by Ulrich and Bassler.

Occurrence.—Ligonodina lexingtonensis is known from the Cherokee shale to the Heebner shale (Oread limestone). It is not as common as *Ligonodina typa*.

Genus LONCHODINA Ulrich and Bassler, 1926

For purposes of description the specimens are oriented with the denticles curved posteriorly and the offset of the bar at the inner posterior side of the superior fang.

LONCHODINA CLARKI (Gunnell)
Plate 20, figures 21, 27, 30, 31

Prioniodus clarki GUNNELL, *1931*, Jour. Paleontology, vol. 5, p. 247, pl. 29, fig. 8.
Prioniodus cornutus STAUFFER AND PLUMMER, *1932*, Univ. Texas Bull., 3201, p. 27, pl. 3, fig. 23.
Prioniodus clarki STAUFFER AND PLUMMER, *1932*, idem., p. 27, pl. 3, figs. 27, 28.

Superior fang long, slender, recurved, sharpest curvature near the base, semicircular to crescent-shaped in cross-section near the base, compressed in upper portion to a sharp pointed lenticular cross-section outline, long axis of which is directed inward and anteriorly, inner sharp edge forming the posterior margin of a groove that extends from near midlength to base of cusp; a similar groove outlined on the outer anterior surface of fang; base of cusp expanded uniformly into a flaring apron on all sides; posterior limb, length unknown, bar-like, bearing subequal, laterally compressed, discrete, recurved denticles; anterior limb directed slightly inward, bar-like, bearing laterally compressed, discrete, recurved denticles subequal in length.

Aboral cavity subelliptical, shallow, posterior portion regularly rounded, bearing a deep median pit, surface marked by fine concentric growth lines, traversed by a groove extended along the aboral edge of both limbs.

Types.—Holotype, Univ. of Missouri C485-3 (G). Hypotypes, C555-1 (figured), C127-1 (figured), and C563-3 (B).

Remarks.—This species differs from *Lonchodina ? ponderosa* in that the bar of the latter is not sharply offset laterally at the superior fang.

Occurrence.—*Lonchodina clarki* is known from the Cherokee shale to the Big Blue series. It is very common in the Des Moines and Missouri series. It is known in the Mineral Wells and Graford formations of Texas.

LONCHODINA ? PONDEROSA Ellison n. sp.
Plate 20, figures 37–39

Superior fang long, slender, slightly recurved, laterally compressed, lenticular-like in cross-section, sharp-edged, and concave outward in vertical section; base of cusp expanded into a flaring apron on the outer side and not on the inner; posterior limb, length unknown, bar-like bearing subequal, laterally compressed discrete, outwardly curved denticles; anterior limb bar-like, directed slightly inward, not sharply offset, bearing laterally compressed, discrete, recurved denticles subequal in length.

Attachment scar, shallow, elongate, expanded, surface marked by fine concentric growth lines; a sharp groove traversing aboral edge of both limbs converges into a median pit.

Types.—Holotype, Univ. of Missouri C90-4 (figured). Paratypes, C99-2 (figured), and C87-5 (figured).

Remarks.—The generic reference of this species is in doubt because no complete specimens have been found. The heavy bar and asymmetrical pit-bearing attachment scar serve to distinguish this species from other Pennsylvanian lonchodinids.

Occurrence.—*Lonchodina ? ponderosa* is known to range from the Cherokee shale to the Heebner shale (Oread limestone).

Genus METALONCHODINA Branson and Mehl, 1941

For purposes of description, the denticles are inclined anteriorly and the short offset limb is anterior. This genus differs from *Lonchodina* in that the anterior limb of the lonchodinids is much longer and the attachment scar is commonly beneath one of the longer denticles.

METALONCHODINA BIDENTATA (Gunnell) Branson and Mehl
Plate 20, figures 35, 36

Prioniodus bidentatus MUNNELL, *1931*, Jour. Paleontology, vol. 5, p. 247, pl. 29, fig. 6.
Prioniodus dactylodus GUNNELL, *1933*, Jour. Paleontology, vol. 7, p. 265, pl. 31, fig. 1.
Metalonchodina bidentata BRANSON AND MEHL, *1941*, Iour. Paleontology, vol. 15, p. 106, pl. 19, fig. 34.

Types.—Holotype, Univ. of Missouri C485-1 (G). Hypotypes, C99-3 to 4 (figured), C489-4 (G), and C560-3 to 5 (B).

Remarks.—This species differs from *Metalonchodina tenora* in that the latter has two large denticles on the anterior limb and the denticles are somewhat coalesced.

Occurrence.—*Metalonchodina bidentata* is known throughout the Des Moines series.

METALONCHODINA TENORA Ellison n. sp.
Plate 20, figure 34

Unit strongly arched; posterior bar thin, bearing laterally compressed partially coalesced denticles curved slightly outward in vertical section; anterior bar thin, bearing two laterally compressed partially coalesced denticles, the anterior one being smallest; denticle above the shallow attachment scar about half as large as largest denticle of anterior limb but larger than those on posterior limb; base of denticle over the attachment scar slightly flaring into an apron; offset of anterior bar is about 160 degrees from posterior bar; anterior margin of the attachment scar regularly rounded, and attachment scar bears a deep median pit.

Holotype.—Univ. of Missouri C99-5 (figured).

Remarks.—This species differs from *Metalonchodina bidentata* in that the latter has only one denticle on the anterior limb and the denticles are not partially coalesced.

Occurrence.—*Metalonchodina tenora* is found in the Cherokee shale and Lexington coal zone.

Genus HINDEODELLA Ulrich and Bassler, 1926

For purposes of description the specimens are oriented with the superior cusp near the anterior end and the denticles inclined posteriorly.

Because the cross-section of the bar and the arrangement of denticles are not constant over the length of a single bar, it seems advisable to establish species primarily on more nearly constant characters such as termini. For this reason but two species are recognized in the following pages. Undoubtedly, many broken specimens which have been given specific names represent one or more additional groups. The materials are not adequate to work out the synonymies of these forms at the present time.

HINDEODELLA PULCHRA Ellison n. sp.
Plate 20, figure 20

Bar long, blade-like, thin, broadly and regularly arched; very short thin anterior limb, bent inward at right angles to plane of posterior limb, bearing a few sharp thin antero-posteriorly compressed, pointed denticles; posterior limb with six to eight large laterally compressed pointed denticles between each pair of which intervene from one, near the posterior end, to five, near the anterior end, small pointed laterally compressed coalesced denticles with discrete termini; posterior terminus thin and terminal denticles inclined posteriorly; germ denticles evident through transmitted light; superior cusp twice as long as bar denticles, elliptical in cross-section near its base, compressed in upper portion with sharp pointed lens-like cross-section outline, long axis of which directed inward and anteriorly, coalesced near its base with denticles on the limbs.

Aboral edge of bar is thin, smooth, and sharp, with a narrow longitudinal groove. No pit evident beneath the superior cusp.

Holotype.—Univ. of Missouri C-555-2 (figured).

Remarks.—This species is longer than *Hindeodella parva* and differs in that the latter has an aborally directed posterior terminus.

Occurrence.—This specimen was obtained from the Hushpuckney shale (Swope limestone).

HINDEODELLA PARVA Ellison n. sp.
Plate 20, figure 29

Bar short, thin, strongly arched with sharpest curvature near the posterior end; very short thin anterior limb, bent inward at right angles to the plane of the posterior limb, bearing a few sharp thin antero-posteriorly compressed pointed denticles; posterior limb with six to eight large, laterally compressed, pointed denticles, between each pair of which intervene, from one near the posterior end to five, near the anterior end, small pointed laterally compressed partially coalesced denticles, with discrete termini; germ denticles evident through transmitted light; superior cusp twice as long as bar denticles, elliptical in cross-section near its base, compressed in upper portion with sharp pointed lenticular cross-section outline long axis of which is directed inward and anteriorly, coalesced near its base with denticles on the limbs.

Aboral edge of bar thin, smooth, and sharp, with a narrow longitudinal groove,

No pit is evident beneath the superior cusp.

Holotype.—Univ. of Missouri C555-3 (figured).

Remarks.—This species differs from *Hindeodella armata* Stauffer and Plummer in that it is shorter and the anterior limb of the latter is directed laterally and aborally.

Occurrence.—The few specimens known are from the Quivira shale.

INDETERMINATE HINDEODELLIDS
Plate 20, figures 18, 19, 23, 24, 32, 33

Hindeodella sp. GUNNELL, *1931*, Jour. Paleontology, vol. 5, p. 249, pl. 29, figs. 11, 12; *1933*, Jour. Paleontology, vol. 7, p. 269, pl. 32, fig. 34.
Hindeodella sp. A-F STAUFFER and PLUMMER, *1932*, Univ. Texas Bull., 3201, p. 35, pl. 1, figs. 1, 2, 11-15, 18.

Bar segments and termini of a great variety of features are illustrated here to show the nature of Pennsylvanian hindeodellids. No attempt to differentiate species on the basis of bar segments is made. It will be noticed, however, that many of the bar segments are extraordinarily long, a distinctive feature of many Pennsylvanian forms.

Hypotypes.—Univ. of Missouri C131-3 (figured), C131-1 (figured), C555-4 (figured), C129-3 (figured), C486-1 (G), C567-2 to 5 (B), C569-1 to 5 (B), and C569-1 (B).

Occurrence.—Hindeodellids are known from the Cherokee shale to the Big Blue series.

Genus HIBBARDELLA Ulrich and Bassler, 1926

For purposes of description the superior cusp and aboral attachment scar are oriented so as to be near the anterior end. The denticles are recurved posteriorly.

HIBBARDELLA SUBACODA (Gunnell)
Plate 20, figures 22, 26

Prioniodus subacodus GUNNELL, *1931*, Jour. Paleontology, vol. 5, p. 246, pl. 29, fig. 5.
Prioniodus missouriensis GUNNELL, *1931*, idem., p. 246, pl. 29, fig. 9.
Idioprioniodus striatus GUNNELL, *1933*, idem., vol. 7, p. 265, pl. 32, figs, 36, 37.

Fang long, recurved, sharpest curvature near base, round in cross-section near base, upper part antero-posteriorly compressed into a flattened sharp terminus; sharp edges of the anterior margin of a groove extends from near midlength to the base of cup on each side of fang; posterior surface marked by a broad groove bearing a low median carina; base uniformly expanded into a flaring apron; abroad-laterally directed limbs bar-like, bearing antero-posteriorly compressed, posteriorly curved, pointed denticles discrete for over one-half their length; posterior limb bar-like, straight or arched, bearing laterally compressed, pointed, recurved discrete denticles.

Aboral cavity shallow, subtriangular, apex directed posteriorly, with fine concentric growth lines, traversed by grooves continued along the aboral edges of the posterior bar and each lateral bar, meeting in a deep median pit.

Types.—Holotype, Univ. of Missouri C484-5 (G). Hypotypes, C554-3 (figured), C485-4 (G), C510-5 (G), and C566-3 (B).

Occurrence.—*Hibbardella subacoda* is known from the Cherokee shale to the Heebner shale (Oread limestone).

Genus PRIONIODINA Ulrich and Bassler, 1926

For purposes of description the specimens are oriented with the shorter limb at the posterior end. The denticles are inclined posteriorly.

Two species are questionably referred to *Prioniodina*. Both depart radically from prioniodinids found in Mississippian faunas, the difference being the partial abortion of the posterior bar of the Pennsylvanian forms.

PRIONIODINA ? CAMERATA (Gunnell)
Plate 20, figures 48, 49, 53

Bryantodus cameratus GUNNELL, *1933*, Jour. Paleontology, vol. 7, p. 268, pl. 32, fig. 47.
Euprioniodina sp. B STAUFFER and PLUMMER, *1932*, Univ. Texas Bull., 3201, p. 32, pl. 2, fig. 34.

Bar thin, blade-like, straight or arched, laterally curved concave inward, thickest part slightly above the aboral edge near the base of denticles; anterior limb long with 10 or more subequal laterally compressed sharp-edged, pointed denticles discrete for over three-fourths their length; posterior limb small, short, commonly with three to five subequal laterally compressed sharp-edged pointed denticles all very much

smaller than those of the anterior limb; superior denticle laterally compressed sharp-edged, pointed, two to three times wider and longer than other denticles, base expanded into a smooth flaring apron on outer side.

Aboral edge with a thin flange on each side; cavity beneath superior cusp deep, asymmetrical, much produced on the outer side, tapered into a narrow longitudinal groove on the aboral edge of both limbs.

Types.—Holotype, Univ. of Missouri C512-3 (G). Hypotypes, C77-4 (figured), C78-4 (figured), and C555-5 (figured).

Remarks.—Specimens that show a progressive loss of denticulate bar posterior to the superior denticle, indicate a complete transition between *Prioniodina ? camerata* and *Gondolella denuda*.

Occurrence.—*Prioniodina ? camerata* is most abundant in the Hushpuckney and Quivira shales of the Missouri series, but specimens are known from the Lexington coal zone to the Eudora shale (Stanton limestone).

PRIONIODINA ? OBTUSA Ellison n. sp.
Plate 20, figures 12, 17

Bar thick, straight to broadly arched, curved laterally, concave inward; anterior limb, length unknown, width subequal laterally compressed, sharp-edged pointed denticles fully discrete, curved posteriorly and inward; posterior limb with denticles slightly smaller than those of anterior limb; superior denticle laterally compressed sharp-edged, pointed, two to three times wider and longer than other denticles, base expanded into a smooth flaring apron.

Aboral edge of bar wide, bearing a longitudinal groove, expanded into a shallow lenticular attachment scar beneath the superior fang; scar with a deep median pit.

Types.—Holotype, Univ. of Missouri C138-4 (figured). Paratype, C131-4 (figured).

Remarks.—Because specimens are incomplete, the generic reference of this species is doubtful. It differs from *Prioniodina ? camerata* in that the latter has a deep conical attachment scar and the denticles are partly coalesced. Figure 17 of plate 20 from the Quivira shale may be an immature form or it may be another species. Material is not adequate to justify the creation of a new species.

Occurrence.—*Prioniodina ? obtusa* is known from the Cherokee shale of the Larsh-Mission Creek shale (Deer Creek limestone).

Genus SYNPRIONIODINA Ulrich and Bassler, 1926

For the purpose of description, the superior denticle and associated attachment scar are placed near the anterior end and the denticles are inclined anteriorly. The angle between the longitudinal axis of the limb and the inclination of the denticles is greatest on the posterior limb. The widest lateral flare at the base of the superior denticle is inward.

SYNPRIONIODINA MICRODENTA Ellison n. sp.
Plate 20, figures 43–46

Synprioniodina sp. GUNNELL, *1933*, Jour. Paleontology, vol. 7, p. 269, pl. 31, fig. 6.

Two blade-like bars in a common plane meet at an angle of 40–55 degrees; posterior bar, length unknown, with many subequal closely spaced, laterally compressed, sharp-pointed denticles partly coalesced and inclined anteriorly to the base of blade about 40 degrees; aborally directed bar commonly shorter than posterior one, with denticles similar to that of the posterior bar but the inclination to base of blade is about 30 degrees; denticles all slightly curved, concave inward in vertical section. Superior fang at apex of angle formed by union of the blades, about twice as long as other denticles, laterally compressed, sharp-pointed, lenticular in cross-section, curved slightly inward in vertical section, expanded at the base on the inward side into a wide flaring apron; outer side not flared.

Aboral attachment scar subelliptical, asymmetrical, traversed by longitudinal groove continued posteriorly and downward along the aboral edges of both blades, terminated in a deep conical pit below the superior fang.

Types.—Holotype, Univ. of Missouri C556-1 (figured). Paratypes, C81-5 (figured), C79-3 (figured), and C490-3 (G).

Remarks.—The ends of the denticulate blades are incomplete because of breakage.

Occurrence.—*Synprioniodina microdenta* is known from the Cherokee shale to the Larsh-Mission Creek shale (Deer Creek limestone). Specimens occur in great abundance in the Missouri series.

Genus SPATHODUS Branson and Mehl, 1933

For purposes of description these specimens are oriented with the superior denticle near the anterior end.

SPATHODUS MINUTUS Ellison n. sp.
Plate 20, figures 50–52

Blade short, thin, laterally straight, broadly arched with aboral edge in anterior half nearly straight; oral edge crenulate with greatest height at superior denticle, gradually decreasing posteriorly to about the fourth from the last denticle, posterior to which it drops sharply to the aboral margin; anterior edge forms an angle of about 45 degrees with the aboral margin; about 12 subequal, laterally compressed, almost completely coalesced denticles posterior to cusp; three short denticles anterior to cusp.

Outline of aboral cavity lachrymoform, broadly rounded anteriorly with posterior point reaching near posterior end of blade, deepest point near anterior end slightly back of superior cusp; cavity traversed by a longitudinal groove which extends along the aboral edge of blade anteriorly and posteriorly.

Types.—Holotype, Univ. of Missouri C556-2 (figured). Paratype, C566-1 (figured, B).

Remarks.—Spathodids are rare in the Pennsylvanian. Therefore, little is known of their range.

Occurrence.—*Spathodus minutus* is found from the Cherokee shale to the Big Blue series.

Genus OZARKODINA Branson and Mehl, 1933

For purposes of description the specimens are oriented so that the denticles are inclined posteriorly and the posterior bar is commonly of smaller size. In laterally curved specimens the concave side is inward.

OZARKODINA DELICATULA (Stauffer and Plummer)
Plate 20, figures 40–42, 47

Bryantodus delicatulus STAUFFER and PLUMMER, *1932*, Univ. Texas Bull., 3201, p. 29, pl. 2, fig. 27.
Bryantodus nasutus STAUFFER and PLUMMER, *1932*, idem., p. 29, pl. 2, fig. 28.
Bryantodus sulcatus STAUFFER and PLUMMER, *1932*, idem., p. 39, pl. 2, figs. 11, 14, 30.
Bryantodus delicatus GUNNELL, *1933*, Jour Paleontology, vol. 7, p. 267, pl. 32, fig. 43.
Bryantodus rugosus GUNNELL, *1933*, idem., p. 268, pl. 32, fig. 44.
Bryantodus strigatus GUNNELL, *1933*, idem., p. 268, pl. 32, fig. 45.
Bryantodus strigillatus GUNNELL, *1933*, idem. p. 268, pl. 32, fig. 46.

Blade-like, thin, straight or orally arched, laterally curved, with limbs of subequal length; blade thickest slightly above the aboral edge near base of denticles; anterior limb with 12 or more laterally compressed subequal, closely spaced, coalesced denticles, discrete only near their tips, inclined at an obtuse angle with base of blade; posterior limb with nine or more laterally compressed subequal, closely spaced, partly coalesced denticles all somewhat smaller than those of anterior limb but making almost a right angle with base of blade; posterior limb of specimens of old individuals are commonly strongly flexed inward near the posterior terminus; apical denticle laterally compressed, sharp-edged, pointed, two to three times as wide and nearly twice as long as other denticles; germ denticles visible in transmitted light.

Aboral edge thin; apical pit long, narrow, deep, with a slightly flaring lip, tapered into a narrow groove on the aboral edge of both limbs.

Hypotypes.—Univ. of Missouri C556-3 (figured), C85-4 (figured), C–B9-7 (figured, B), C–B9-2 (figured, B), C511-4 to 5 (G), C512-1 to 2 (G), C563-4 to 5 (B), C564-1 to 5 (B), and C565-1 to 5 (B).

Remarks.—Specimens in the Virgil and Big Blue series tend to be smaller and more delicate than those of the Des Moines and Missouri series.

Occurrence.—*Ozarkodina delicatula* is known from the Cherokee shale to the Big Blue series.

Genus GONDOLELLA Stauffer and Plummer, 1932

Gondolella STAUFFER and PLUMMER, *1932*, Univ. Texas Bull., 3201, p. 41; GUNNELL, *1933*, Jour. Paleontology, vol. 7, p. 287.

Tooth blade-like to platform-like; platform canoe- or gondola-shaped, elongate, commonly laterally curved and arched, with posterior end blunt and anterior commonly produced as a median blade; outline of

plate regular or interrupted on one side by a short accessory lobe near the posterior end; oral surface transversely convex to concave, with or without transverse ridges, broken by a longitudinal median carina consisting of laterally compressed partly coalesced denticles that are aligned with the blade.

Aboral side of platform smooth, flat or transversely convex, bearing a median longitudinal keel, which is transversed by a longitudinal furrow expanded at the blunt end of plate into a shallow flaring asymmetrical loop-like attachment scar; surface of scar with fine concentric growth lines.

For purposes of description the specimens are oriented with the denticles inclined posteriorly and the aboral attachment scar and superior denticles near the posterior end. In specimens that are laterally curved the concave side is inward. If an accessory lobe is present, it is on the outer side.

GONDOLELLA DENUDA Ellison n. sp.
Plate 20, figure 54
Plate 21, figures 1, 2, 36

Blade-like, consisting of 15 or more subequal denticles discrete for over three-fourths their length; posterior denticle larger than other denticles, pointed, sharp-edged, conical and discrete; basal part of posterior end expanded into a flaring apron; lip of keel evident the full length of specimen; blade thickest a short distance above the aboral margin at the base of the denticles.

Asymmetric loop-like attachment scar below superior denticle continued anteriorly as a furrow along the aboral edge of blade.

Types.—Holotype, Univ. of Missouri C557-1 (figured). Paratypes, C184-4 (figured), C170-5 (figured), and C169-2 (figured).

Remarks.—This species is distinct because it lacks a platform. Figure 36 of plate 21 shows a pathological specimen of this species which has a laterally extended accessory blade. All gradational forms are known between *Prioniodina ? camerata* through *Gondolella denuda* to the typical platform gondolellids. A single sample may produce all of the transition forms.

Occurrence.—*Gondolella denuda* is very abundant in the Hushpuckney shale and a few specimens have been found in the Queen Hill shale (Lecompton limestone).

GONDOLELLA BELLA Stauffer and Plummer
Plate 21, figures 6, 10, 14

Gondolella bella STAUFFER and PLUMMER, *1932*, Univ. Texas Bull., 3201, p. 42, pl. 3, figs. 3, 4.
Gondolella minuta STAUFFER and PLUMMER, *1932*, idem., p. 44, pl. 3, figs. 1, 3.

Platform subsymmetrical, lanceolate; sides smooth, tapered anteriorly from greatest width near posterior one-third, tapered posteriorly to coalesce with long posteriorly projecting superior cusp; oral surface concave in transverse section, may or may not be ornamented with a very few faint transverse parallel undulations obsolescent toward the carina; no bevelling effect present.

Carina delicate, relatively high, consisting of seven to ten laterally compressed, partly coalesced sharp-edged denticles discrete for over one-half their lengths; posterior cusp long, posteriorly projecting and intimately fused with posterior end of platform; basal part of posterior end expanded into a short apron.

Aboral surface of platform transversely convex, smooth; keel narrow, tapered to anterior point and very prominent anteriorly; keel expanded into a small asymmetrical loop-like cavity at the posterior end.

Hypotype.—Univ. of Missouri C557-2 (figured).

Remarks.—These very small forms may possibly be immature specimens of *Gondolella elegantula* or *G. symmetrica*. *G. bella* differs from *G. elegantula* in that the latter has a blade extended beyond the platform and the oral surface is ornamented with ridges. The presence of an extra posterior denticle in some specimens does not seem to be of specific value as was suggested by Stauffer and Plummer in naming *G. minuta*.

Occurrence.—*Gondolella bella* is known from the Bourbon formation to the Queen Hill shale (Lecompton limestone). It is also known from the Graford and Mineral Wells formations of Texas.

GONDOLELLA ELEGANTULA
Stauffer and Plummer
Plate 21, figures 7, 11, 15

Gondolella elegantula STAUFFER and PLUMMER, *1933*, Univ. Texas Bull., 3201, p. 42, pl. 3, figs. 5, 8, 9.

Gondolella insolita STAUFFER and PLUMMER, *1933*, idem., p. 43, pl. 3, figs. 15, 22.
Gondolella lanceolata STAUFFER and PLUMMER, *1933*, idem., p. 43, pl. 3, figs. 12, 16.

Platform subsymmetrical, lanceolate, with smooth regular sides, tapered anteriorly from greatest width near posterior one-third, tapered posteriorly to coalesce with long posteriorly projecting subtriangular superior cusp; oral surface concave in transverse section, may or may not be ornamented with a few faint transverse parallel ridges obsolescent toward the carina; no bevelling effect present.

Carina moderately high consisting of 11 or more laterally compressed, partly coalesced, sharp-edged denticles discrete for over one-half their length; large posteriorly projecting cusp, subtriangular in cross-section; basal part of posterior end expanded into a widely flaring apron.

Aboral surface of platform smooth, transversely convex; keel narrow, uniformly tapered to anterior point; outer side of loop slightly more extended laterally than inner side.

Hypotype.—Univ. of Missouri C557-4 (figured).

Remarks.—Stauffer and Plummer's three species, placed in synonymy here, differ only in the number of denticles, presence or absence of transverse ridges, and the arching of the axis. These variables seem to be allowable in a single species. *Gondolella elegantula* differs from *G. bella* in that the latter is smaller in size and lacks sharp oral transverse ridges. *G. bella* possesses no anterior blade extension as in *G. elegantula*.

Occurrence.—*Gondolella elegantula* is known from the Bourbon formation to the Queen Hill shale (Lecompton limestone). It is also known from the Graford and Mineral Wells formations of Texas.

GONDOLELLA SYMMETRICA Ellison n. sp.
Plate 21, figures 3, 4, 17, 21, 26, 30

Platform symmetrical, boat-like, with sides tapered gradually anteriorly to coalesce with the anterior blade about the fifth denticle from the anterior end; sides tapered posteriorly to the regularly rounded posterior end; oral surface concave in transverse section, ornamented with irregular transverse sharp-crested ridges, obsolescent toward the carina, prominent on inner side of platform and commonly absent on the outer side; no bevelling effect of lateral margins.

Carina deeply crenulate, relatively high, consisting of 12 or more laterally compressed, partially coalesced denticles, discrete for about half their length; posterior cusp long, diamond-shaped in cross-section with longest diagonal directed laterally; sharp lateral edges of cusp coalesced with the margins of the platform near the base of cusp; apron broadly flared.

Aboral surface of platform smooth; keel narrow, uniformly tapered to an anterior point; outer side of loop somewhat more laterally extended than inner side.

Types.—Holotype, Univ. of Missouri C558-2 (figured). Paratypes, C558-1 (figured), and C170-4 (figured).

Remarks.—This species differs from *Gondolella sublanceolata* in that the latter has the margins of the platform bevelled by cups and ridges.

Occurrence.—*Gondolella symmetrica* is known only from the Hushpuckney shale (Swope limestone) and the Stark shale (Dennis limestone).

GONDOLELLA SUBLANCEOLATA Gunnell
Plate 21, figures 18, 19, 22, 23, 34, 35

Gondolella sublanceolata GUNNELL, *1933*, Jour. Paleontology, vol. 7, p. 287, pl. 32, figs. 53, 55, not fig. 54.

Platform sublanceolate, asymmetrical, with sides parallel in the posterior one-third of specimen and tapered anteriorly toward the carina; oral surface, concave in transverse section, ornamented by faint transverse irregular ridges that are obsolescent toward the carina; the lateral margins of posterior half of platform bevelled by a series of low cups and ridges; bevelling effect decreases anteriorly and disappears near midlength.

Carina high, moderately crenulate, consisting of 11 or more laterally compressed, partially coalesced sharp-edged denticles, discrete only near their tips; posterior cusp moderately long, subtriangular in cross-section, one apex of which is directed anteriorly; anterior surface of cusp with a median ridge that is coalesced with the carina near base of cusp; apron widely flared.

Aboral surface of platform smooth; keel narrow, uniformly tapered to an anterior point; outer side of loop somewhat more extended laterally than inner side.

Types.—Holotype, Univ. of Missouri C513-1 (G). Hypotypes, C557-3 (figured), C558-3 (figured), and C169-3 (figured).

Remarks.—This species differs from *Gondolella elegantula* in that the latter has a relatively longer posterior cusp, lacks marginal platform bevelling, and lacks a shoulder-like outline of the posterior end of platform. It differs from *G. merrilli* in that the latter lacks a blade extended beyond the platform, has a relatively low carina, and a relatively shallow transversely concave oral surface.

Figures 34 and 35 of plate 21 show a pathological specimen that may be referred to this species. The posterior cusp has three additional denticles posterior and lateral to its posterior surface, forming a fan-like blade.

Occurrence.—*Gondolella sublanceolata* is known from the Bourbon formation to the Eudora shale (Stanton limestone).

GONDOLELLA MERRILLI Gunnell
Plate 21, figures 5, 9, 13, 40

Gondolella merilli GUNNELL, *1933*, Jour. Paleontology, vol. 7, p. 287, pl. 32, figs. 48, 49, 50.
Gondolella lingulata GUNNELL, *1933*, idem., p. 287, pl. 32, figs. 51, 52.
Gondolella sinuata GUNNELL, *1933*, idem., p. 287, pl. 32, fig. 58, not figs. 56, 57.
Gondolella sublanceolata GUNNELL, *1933*, idem., p. 287, pl. 32, fig. 54, not figs. 53, 55.

Platform subsymmetrical, sublanceolate, with sides slightly crenulate and parallel in posterior half, anterior to which the sides taper gradually to a blunt anterior point with no blade extension beyond the platform; oral surface of platform slightly concave in transverse section, ornamented by transverse sharp-crested ridges obsolescent toward the carina; lateral margins of platform bevelled by cups and ridges near midlength; anteriorly and posteriorly the bevelling disappears; lateral margins near the posterior end project orally creating deep longitudinal trenches on both sides of the carina; carina very low, slightly crenulate, consisting of 13 laterally compressed, low node-like denticles with discrete termini; large posterior cusp, short, blunt, conical and may bear an accessory denticle posteriorly or laterally; basal part of posterior end expanded into a flaring apron.

Aboral surface of platform smooth, slightly undulating, transversely convex; keel narrow, uniformly tapered to an anterior point; outer side of loop somewhat more extended laterally than inner side.

Types.—Holotype, Univ. of Missouri C512-4 (G). Hypotypes, C557-5 (figured), C159-3 (figured), C512-5 (G), and C513-2 (G).

Remarks.—This species differs from *Gondolella sublanceolata* in having a shallow oral surface and in not having the blade extended beyond the platform.

Occurrence.—*Gondolella merrilli* is known from the Hushpuckney shale (Swope limestone) to the Eudora shale (Stanton limestone).

GONDOLELLA CURVATA
Stauffer and Plummer
Plate 21, figures 25, 29, 33, 38, 39

Gondolella curvata STAUFFER and PLUMMER, *1932*, Univ. Texas Bull., 3201, p. 42, pl. 3, figs. 13, 14, 17.

Platform subsymmetrical, pointed at both ends; sides tapered anteriorly and posteriorly from greatest width about midlength; oral surface flat to slightly concave in transverse section, ornamented by many transverse parallel sharp-crested ridges that are obsolescent toward the carina; some of the ridges bifurcate near the margins of the platform; no bevelling effect present; carina very low consisting of a row of seven or more conical nodes; no anterior blade extension of carina; posterior cusp long, subtriangular in cross-section, projected posteriorly, lateral sides coalesced with margins of platform; anterior surface of cusp with a median ridge that is coalesced with the carina near base of cusp; apron widely flared.

Aboral surface smooth and slightly undulating; keel broad, uniformly tapered to an anterior point; outer side of loop somewhat more laterally extended than inner side.

Hypotypes, Univ. of Missouri C169-4 to 5 (figured), and C159-4 to 5 (figured).

Remarks.—This species differs from *Gondolella elegantula* in that the latter is not so wide and does not have the flattened platform. It differs from *G. merrilli* in that the

posterior end of the latter is distinctly shoulder-like in outline.

Occurrence.—*Gondolella curvata* is known from the top of the Cherokee shale and the Lexington coal zone. It was first named from the Mineral Wells formation of Texas.

GONDOLELLA MAGNA Stauffer and Plummer
Plate 21, figure 37

Gondolella magna STAUFFER AND PLUMMER, *1933*, Univ. Texas Bull., 3201, p. 43, pl. 3, figs. 6, 7, 10, 11.

Hypotype.—Univ. of Missouri C169-1 (figured).

Remarks.—Stauffer and Plummer's description seems to be adequate. The figured specimen is not exactly like the one first described but the variation in oral ornamentation seems allowable in this species.

Occurrence.—*Gondolella magna* is known from the Lexington coal zone and Mineral Wells formation.

GONDOLELLA COSTATA Ellison n. sp.
Plate 21, figures 20, 24

Platform, subelliptical, long, asymmetrical; sides crenulate, tapered anteriorly toward carina from the greatest width near midlength and tapered posteriorly to the shoulder-like posterior end; no accessory lobe; oral surface slightly concave in transverse section, ornamented by parallel transverse sharp-crested ridges radiating anteriorly from the carina and obsolescent toward the carina; rounded lateral margins of platform ornamented with regularly spaced corrugations radiating anteriorly and separated from concave portion of platform by sinuous longitudinal ridges; lateral margins in posterior one-fourth of platform not covered by corrugations but projected orally, creating a deep concavity on each side of the carina at the posterior end.

Carina low, crenulate, consisting of 15 or more laterally compressed, blunt pointed denticles discrete only near their tips; superior cusp short, blunt, conical and coalesced at the base with posterior margins of platform; apron short widely flaring; keel visible only in anterior one-fourth of specimen.

Aboral surface of platform slightly undulate; keel wide, uniformly tapered to a blunt anterior point, depressed into aboral surface of platform for most of its length; outer side of loop extended laterally a greater distance than inner side.

Holotype.—Univ. of Missouri C559-2 (figured).

Remarks.—This species differs from *Gondolella neolobata* in that the latter possesses an accessory lobe. It is distinguished from other species by its broad, flattened, and rounded appearance.

Occurrence.—*Gondolella costata* is found in the Hushpuckney shale (Swope limestone), the Stark shale (Dennis limestone), and the Quivira shale.

GONDOLELLA DUBIA Ellison n. sp.
Plate 21, figures 8, 12, 16

Platform long, narrow, wedge-shaped, regular shoulder-like posterior outline broken by an accessory lobe; oral surface of platform transversely convex, ornamented with transverse ridges radiating anteriorly and extending on to the rounded lateral margins of the platform. Some of the ridges extend toward the carina and coalesce with the denticles of the carina.

Lip of keel evident its full length, slightly sinuous in outline; carina high, crenulate in anterior portion, consisting of 19 or more laterally compressed denticles, the posterior six of which are coalesced to form a heavy regular longitudinal ridge; posterior cusp subtriangular in cross-section one apex of which is directed posteriorly; anterior surface of cusp slightly concave with a median ridge that coalesces near the base with carina; base of cusp widest portion of specimen.

Aboral surface of platform smooth; keel narrow, uniformly tapered to an anterior point; outer side of loop extended a greater distance laterally than inner side.

Holotype.—Univ. of Missouri C559-1 (figured).

Remarks.—This species differs from *Gondolella neolobata* in that the latter is not slender and wedge-shaped, does not possess the relatively large posterior cusp, and has a low carina.

Occurrence.—*Gondolella dubia* is known only from the Hushpuckney shale (Swope limestone).

GONDOLELLA LOBATA Ellison n. sp.
Plate 21, figures 27, 31, 41

Platform, wedge-shaped, subelliptical; sides crenulate, tapered anteriorly from the greatest width at the posterior end; regular outline of shoulder-like posterior end broken by an accessory lobe; oral surface of platform concave in transverse section, ornamented with sharp-crested irregular transverse ridges that radiate anteriorly and are obsolescent toward the carina; lateral margins bevelled by irregular cups and ridges except posterior one-fourth of platform which projects to form a deep concavity on both sides of the carina; oral surface of lobe nodose and ridged; carina low, crenulate, consisting of 14 or more laterally compressed partially coalesced denticles; posterior denticle conical, low, and blunt.

Aboral surface of platform smooth; keel wide, uniformly tapered to a blunt anterior point; outer side of loop extended laterally twice as far as inner side.

Types.—Holotype, Univ. of Missouri C558-4 (figured). Paratype, C144-5 (figured).

Remarks.—This species differs from *Gondolella neolobata* in that the latter is relatively wider, has many regular corrugations on the rounded margins, and has the keel depressed into aboral surface of platform. It differs from *G. dubia* in that the latter is very long and slender, possesses a large superior denticle, and has a high carina. Other species of *Gondolella* differ from this one in that they lack an accessory lobe.

Occurrence.—*Gondolella lobata* is known from the Hushpuckney shale (Swope limestone), the Quivira shale, and the Eudora shale (Stanton limestone).

GONDOLELLA NEOLOBATA Ellison n. sp.
Plate 21, figures 28, 32

Platform subelliptical, long, asymmetrical; sides crenulate, tapered anteriorly toward carina from greatest width near midlength and tapered posteriorly to shoulder-like posterior end, regularity of which is broken by an accessory lobe; oral surface, slightly concave in transverse section, ornamented by parallel transverse sharp-crested ridges radiating anteriorly from the carina and obsolescent toward the carina; rounded lateral margins of platform ornamented with regularly spaced corrugations radiating anteriorly and separated from concave portion of platform by sinuous longitudinal ridges; lateral margins in the posterior one-fourth of platform not covered by corrugations but projected orally creating deep concavities on each side of the carina at the posterior end.

Carina low, crenulate, consisting of 15 or more laterally compressed blunt pointed denticles discrete only near their tips; superior cusp short, blunt, conical and coalesced at its base with posterior margins of platform; apron short, strongly curved outward; keel visible only in anterior one-fourth of specimen.

Aboral surface of platform slightly undulate; keel wide, uniformly tapered to a blunt anterior point, depressed into aboral surface of platform for most of its length; outer side of loop extended laterally about twice as far as inner side.

Holotype.—Univ. of Missouri C558-5 (figured).

Remarks.—This species differs from *Gondolella lobata* in that the latter does not have the prominent corrugations on the lateral surface of the platform and the keel is not depressed into the aboral surface of the platform. *G. costata* differs only in the lack of the accessory lobe.

Occurrence.—*Gondolella neolobata* is known only from the Quivira shale and the Eudora shale (Stanton limestone).

Genus CAVUSGNATHUS Harris and Hollingsworth, 1933

Cavusgnathus HARRIS and HOLLINGSWORTH, *1933*, Amer. Jour. Sci., 5th ser., vol. 25, p. 200; GUNNELL, *1933*, Jour. Paleontology, vol. 7, p. 286.

Elongate platform-like teeth with high sides extending parapet-like above a median longitudinal trench; one parapet continued into a free longitudinal blade and connected at the posterior end to opposite parapet whose length is limited by the length of the platform; aboral surface of platform smooth, deeply excavated as a longitudinally elongate laterally asymmetrical, spathodid-like cup, pointed at each end, traversed by a median longitudinal groove which extends to

the ends of the platform and along the aboral edge of blade; sides of platform somewhat constricted laterally above the aboral margin to produce a lip-like lateral margin of variable width; oral surface of platform more or less grooved transversely; oral edge of blade denticulate and crenulate.

For purposes of description the blade is directed anteriorly. It is continued posteriorly as the outer edge of platform, the blade parapet. The elevated inner edge of the platform is the inner parapet.

Remarks.—This genus differs from *Idiognathodus* in that the blade of the latter is median. It differs from *Polygnathodella* Harlton in that the latter has no oral trough.

CAVUSGNATHUS LAUTA Gunnell
Plate 21, figures 47, 48

Cavusgnathus lautus GUNNELL, *1933*, Jour. Paleontology, vol. 7, p. 286, pl. 31, figs. 67, 68, pl. 33, fig. 9.
Cavusgnathus missouriensis GUNNELL, *1933*, idem., pl. 33, figs. 10, 11.

Platform long, lanceolate, posteriorly pointed; inner and outer parapets ornamented with regularly spaced parallel transverse ridges obsolescent toward the deep oral trough; trough deepest at posterior end of platform; outer parapet continued into blade bearing laterally compressed closely spaced subequal denticles rising only a short distance above elevation of platform; aboral attachment scar very slender, shallow, and not widely flared; sides of platform almost vertical, constricted only slightly.

Types.—Holotype, Univ. of Missouri C502-3 (G). Hypotypes, C556-5 (figured), C516-1 to 3 (G), and C502-4 (G).

Remarks.—This species differs from *Cavusgnathus flexa* in that the latter has a rounded posterior end, widely flaring apron, and a more or less sinuous inner parapet. *C. giganta* differs in that it bears a very large denticle at the junction of blade with outer parapet and has a widely flaring apron.

Occurrence.—*Cavusgnathus lauta* is known from the Stark shale (Dennis limestone) to the Big Blue series.

CAVUSGNATHUS GIGANTA Gunnell
Plate 21, figures 44, 45, 49

Cavusgnathus gigantus GUNNELL, *1933*, Jour. Paleontology, vol. 7, p. 286, pl. 31, figs. 7, 8.

Platform long, lanceolate, posteriorly pointed; inner and outer parapets ornamented with regularly spaced parallel transverse ridges obsolescent toward the deep oral trough; trough deepest at posterior end of platform; inner parapet slightly sinuous in outline; outer parapet continued into blade bearing laterally compressed closely spaced denticles the posterior one of which is very much larger than the others and rises abruptly above the elevation of the platform; aboral attachment scar long, widely flaring and moderately deep; sides of the platform constricted particularly near the posterior end.

Types.—Holotype, Univ. of Missouri C515-5 (G). Hypotypes, C556-4 (figured), and C143-4 (figured).

Remarks.—This species is larger than *Cavusgnathus lauta* and *C. flexa*. It differs from *C. flexa* in that the latter does not possess a large denticle on the blade. It differs from *C. lauta* in that the latter does not possess a large denticle on the blade nor is there a widely flaring apron.

Occurrence.—*Cavusgnathus giganta* occurs from the Cherokee shale to the Big Blue series.

CAVUSGNATHUS FLEXA Ellison n. sp.
Plate 21, figures 42, 43, 46

Platform long, lanceolate, posteriorly rounded; axis of platform moderately flexed inward; inner and outer parapets ornamented with regularly spaced parallel transverse ridges obsolescent toward the deep oral trough and slightly radiating at the posterior end; outer parapet continued into blade, bearing laterally compressed subequal denticles; aboral attachment scar very slender, moderately deep widely flared and flexed to correspond to flexure of platform axis; sides of platform almost vertical on the outer side but constricted on the inner side so that the inner parapet overhangs.

Holotype.—Univ. of Missouri C144-2 (figured).

Remarks.—This species differs from *Cavusgnathus lauta* in that the posterior end of the latter is pointed and the apron is not widely flared. It differs from *C. giganta* in that the latter possesses a large denticle at the posterior end of blade.

Occurrence.—*Cavusgnathus flexa* is known

from the Hushpuckney shale (Swope limestone) to the Big Blue series.

Genus STREPTOGNATHODUS Stauffer and Plummer, 1932

Streptognathodus STAUFFER and PLUMMER, *1932*, Univ. Texas Bull., 3201, p. 47; GUNNELL, *1933*, Jour. Paleontology, vol. 7, p. 269.
Polygnathus (in part) HARRIS and HOLLINGSWORTH, *1933*, Amer. Jour. Sci., 5th ser., vol. 25, p. 202.

The blade is the anterior denticulate process. This attaches in a median position to the platform. The platform may bear laterally directed nodose processes called accessory lobes. The large excavated aboral surface of the platform is the attachment scar. For purposes of description the blade is directed anteriorly. The side of the aboral attachment scar having the greatest lateral extension near the anterior portion of the platform is designated the inner side. If the axis of the tooth is curved laterally, the concave side is inward.

Remarks.—Because *Streptognathodus* and *Idiognathodus* are supposed to be derivatives of the primitive genus *Spathodus*, the anterior and posterior ends are placed opposite to the orientation given by Stauffer and Plummer. This alteration gives uniformity to the orientation of platform-like and blade-like conodonts. Except for orientation, Stauffer and Plummer's description of this genus seems to be adequate.

Streptognathodus and *Idiognathodus* are alike in the structure of the attachment scar, which in this case occupies the entire aboral surface. The anterior blade, the outline in oral view, including shape, size and number of nodose accessory lobes, and the outline in lateral view are the same in both genera. The lateral curvature and oral arching of the longitudinal axis are also similar. Structurally, therefore, the only difference between the two genera is the ornamentation of the oral surface. *Streptognathodus* has an oral longitudinal trough or groove and *Idiognathodus* does not. In form, *Streptognathodus cancellosus*, *S. eccentricus*, *S. multinodosus*, and *S. simulator* represent borderline species which are transitional between the two genera. This gradual change in form from one genus to another seems to be the result of a filling of the oral trough and completion of transverse ridges from one side to the other.

Streptognathodus differs from *Polygnathus* in that the attachment scar of the latter is a very small pit on the aboral transversely convex surface. The attachment scar of *Streptognathodus* is a large deeply excavated cup. *Streptognathodus* differs from *Cavusgnathus* in that the anterior blade of the latter merges with the side of the oral surface of the platform.

Gnathodus differs from *Streptognathodus* in that the carina of the former is commonly prominent the full length of the platform and no accessory lobes are developed on the platform. *Gnathodus* may acquire a distinctly radial ornamentation on the platform and in this acquisition become subcircular in platform outline.

Specific descriptions of both *Streptognathodus* and *Idiognathodus* deal mainly with oral surface features because the lateral and aboral views of most species are alike. The following features are used to determine species of both genera: the presence, or absence and number of accessory lobes; depth and position of the oral longitudinal trough; the general platform shape; shape of posterior terminus; and the general design and arrangement of oral ornamentation. Little attention is given to the minutia of ridge and node arrangement because each specimen differs in some way from all others.

STREPTOGNATHODUS ELEGANTULUS Stauffer and Plummer
Plate 22, figures 1–6, 10

Streptognathodus elegantulus STAUFFER and PLUMMER, *1932*, Univ. Texas Bull., 3201, p. 47, pl. 5, figs. 6, 7, 22, 27.
Polygnathus pawhuskensis HARRIS and HOLLINGSWORTH, *1933*, Amer. Jour. Sci., 5th ser., vol. 25, pp. 199–200, pl. 1, figs. 12a, b.

Outline of platform in oral view, long, slender, lanceolate, posteriorly pointed, greatest width near midlength; no accessory lobes; transverse section of oral surface deeply concave; oral surface ornamented with 10 or more parallel transverse ridges obsolescent toward the deep median longitudinal trough; blade of average length consisting of 10 to 25 denticles continued posteriorly as a carina in the oral trough for

about one-third the length of the platform; carina may continue posteriorly in the trough as a row of nodes regularly spaced in alignment with the transverse ridges; carina set off from platform on either side by deep sulci that merge into the trough posteriorly so that the lateral margins of the anterior portion of the platform extend as free edges.

Hypotypes.—Univ. of Missouri C265-1 (figured), C559-4 (figured), C265-5 (figured), and C264-3 (figured).

Remarks.—This is a remarkably constant species. The row of nodes, which may or may not be present, in the oral trough is the only variable. It is easily recognized by the deep median trough and lack of accessory lobes. It differs from *Streptognathodus excelsus* and *S. gracilis* in that the latter two have accessory lobes.

Occurrence.—*Streptognathodus elegantulus* occurs sparingly in the Des Moines series, abundantly in many of the Missouri series zones, and is the dominant conodont species of the Virgil series. It also occurs in the Graford and Mineral Wells formations of Texas and in the Pawhuska formation of Oklahoma.

STREPTOGNATHODUS GRACILIS
Stauffer and Plummer
Plate 22, figures 7, 11

Streptognathodus gracilis STAUFFER and PLUMMER, *1932*, Univ. Texas Bull., 3201, p. 48, pl. 4, figs. 12, 23.

EXPLANATION OF PLATE 22
(All figures 28×)

FIGS. *1–6, 10—Streptognathodus elegantulus* Stauffer and Plummer. *1, 4,* Oral and lateral views, Larsh-Mission Creek shale. (Sample 0043 E.; specimen, Univ. Missouri C265-1). *2, 5,* Oral and aboral views, Muncie Creek shale. (Sample 1354 U. M.; specimen, Univ. Missouri C559-5). *3, 6,* Oral and lateral views, Larsh-Mission Creek shale. (Sample 0043 E.; specimen, Univ. Missouri C265-5). *10,* Oral view, Holt shale. (Sample 0013 E.; specimen, Univ. Missouri C264-3). (p. 127)

7, 11—Streptognathodus gracilis Stauffer and Plummer. Oral and aboral views, Quivira shale. (Sample 1362 U. M.; specimen, Univ. Missouri C560-5). (p. 128)

8, 12—Streptognathodus sulcatus Gunnell. *8,* Oral view, Muncie Creek shale. (Sample 1354 U. M.; specimen, Univ. Missouri C560-4). *12,* Oral view of senile specimen, Quivira shale. (Sample 0107 E.; specimen, Univ. Missouri C224-4). (p. 130)

9—Streptognathodus elongatus Gunnell. Oral view, Hughes Creek shale. (Sample 0028 E.; specimen, Univ. Missouri C264-4). (p. 130)

13, 14, 16—Streptognathodus oppletus Ellison, n. sp. *13,* Oral view of holotype, Quivira shale. (Sample 1283 U. M.; specimen, Univ. Missouri C515-3). *14,* Oral view of senile specimen, Hushpuckney shale. (Sample 0155 E.; specimen, Univ. Missouri C264-2). *16,* Oral view, Stark shale. (Sample 0108 E.; specimen, Univ. Missouri C234-1). (p. 132)

15, 17, 20—Streptognathodus excelsus Stauffer and Plummer. *15,* Oral view, Quivira shale. (Sample 1362 U. M.; specimen, Univ. Missouri C560-2). *17,* Oral view of senile specimen showing oral trituration, Muncie Creek shale. (Sample 1354 U. M.; specimen, Univ. Missouri C559-3). *16,* Oral view of senile specimen, Eudora shale. (Sample 0001 E.; specimen, Univ. Missouri C263-4). (p. 130)

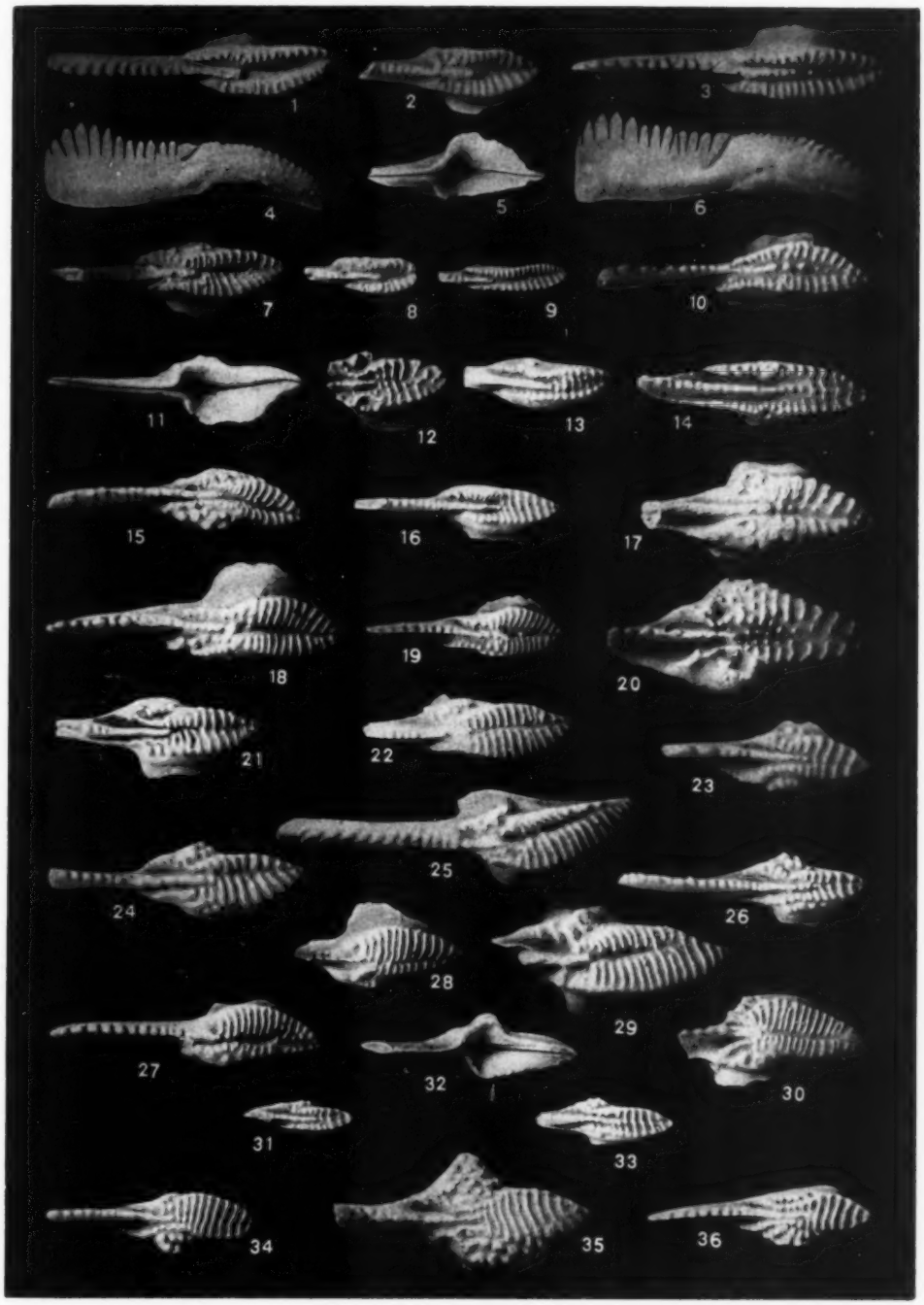
18, 19, 21, 22—Streptognathodus wabaunsensis Gunnell. *18, 19,* Two oral views, Hughes Creek shale. (Sample 0028 E.; specimens, Univ. Missouri C263-5 and C263-2). *21,* Oral view, Eudora shale. (Sample 0001 E.; specimen, Univ. Missouri C263-3). *22,* Oral view, Muncie Creek shale. (Sample 1354 U. M.; specimen. Univ. Missouri C560-3). (p. 131)

23, 26—Streptognathodus cancellosus (Gunnell). *23,* Oral view, Muncie Creek shale. (Sample 1354 U. M.; specimen, Univ. Missouri C559-4). *26,* Oral view, Hushpuckney shale. (Sample 0155 E.; specimen, Univ. Missouri C257-4). (p. 131)

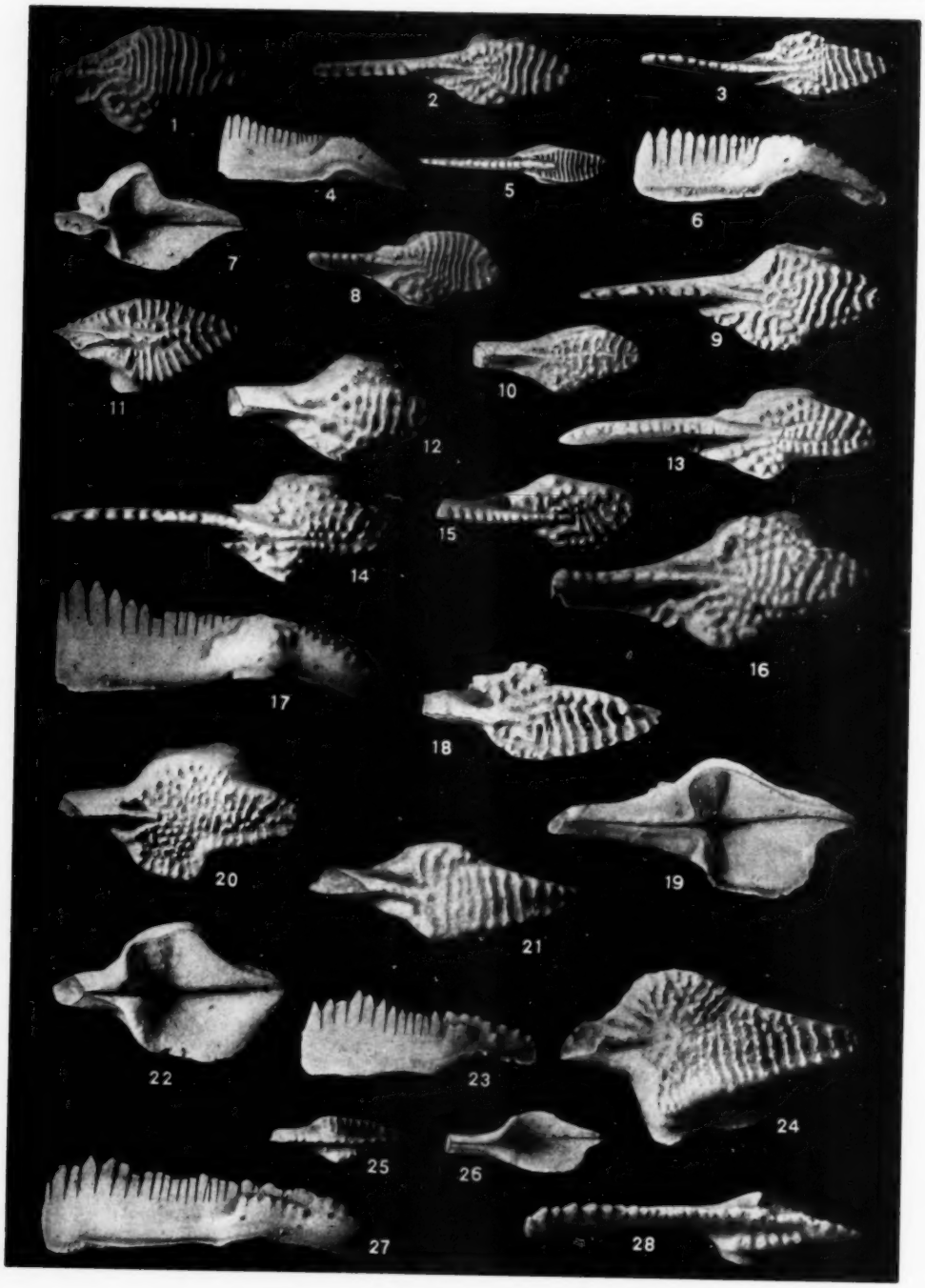
24—Streptognathodus eccentricus Ellison, n. sp. Oral view of holotype, Hushpuckney shale. (Sample 1459 U. M.; specimen, Univ. Missouri C560-1). (p. 132)

25, 27–30—Streptognathodus simulator Ellison, n. sp. *25,* Oral view of holotype, Heebner shale. (Sample 0097 E.; specimen, Univ. Missouri C257-5). *27–30,* Oral views, Heebner shale. (Sample 0081 E.; specimens, Univ. Missouri C257-2 to 3, C256-5, and C255-5). (p. 132)

31–36—Idiognathodus delicatus Gunnell. *31,* Oral view of immature specimen, Hushpuckney shale. (Sample 0155 E.; specimen, Univ. Missouri C248-3). *33,* Oral view of immature specimen, Stark shale. (Sample 0108 E.; specimen, Univ. Missouri C234-2). *32, 34,* Aboral and oral view, Quivira shale. (Sample 1362 U. M.; specimen, Univ. Missouri C561-2). *35,* Oral view of senile specimen, Hushpuckney shale. (Sample 1359 U. M.; specimen, Univ. Missouri C561-3). *36,* Oral view of average specimen, Mulky coal zone. (Sample 0176 E.; specimen, Univ. Missouri C252-4). (p. 134)



Ellison, Pennsylvanian Conodonts



Ellison, Pennsylvanian Conodonts

Streptognathodus holmesi GUNNELL, *1933*, Jour. Paleontology, vol. 7, p. 280, pl. 32, figs. 1, 2.
Streptognathodus sulciferous GUNNELL, *1933*, idem., p. 281, pl. 32, fig. 12.
Streptognathodus corrugatus GUNNELL, *1933*, idem., p. 281, pl. 32, fig. 13.
Streptognathodus rugosus GUNNELL, *1933*, idem., p. 282, pl. 32, fig. 18.
Streptognathodus curvatus GUNNELL, *1933*, idem., p. 283, pl. 33, fig. 1.

Outline of platform in oral view long, slender, lanceolate, posteriorly pointed, greatest width near anterior one-third; accessory lobe on inner side; surface of lobe nodose, number of nodes varies from one to 15; transverse section of oral surface deeply concave; oral surface ornamented with 10 or more parallel transverse ridges obsolescent toward the deep median trough; blade of average length, consisting of 10 to 25 denticles continued posteriorly as a carina in the oral trough for about one-third of length of the platform; carina may continue posteriorly in the trough as a row of nodes regularly spaced in alignment with the transverse ridges; carina set off from platform on either side by deep sulci that merge into the trough posteriorly so that the lateral margins of the anterior portion of the platform extend as free edges.

Hypotypes.—Univ. of Missouri C560-5 (figured), C504-1 (G), C505-5 (G), C506-1 (G), C507-1 (G), and C514-4 (G).

Remarks.—The number of nodes on the accessory lobe and the posterior extension of the row of nodes in the median oral trough are variable. This species is restricted to those specimens with one accessory lobe. It differs from *Streptognathodus elegantulus* in that the latter has no accessory lobe. *S. gracilis* differs from *S. excelsus* in that the latter has two accessory lobes. *S. wabaunsensis* is distinct because it has a shallow median oral trough. *S. simulator* differs in that the oral trough is not median.

Occurrence.—*Streptognathodus gracilis* is very abundant in the Missouri and Virgil series. It is known from the Graford and Mineral Wells formations of Texas.

EXPLANATION OF PLATE 23

(All figures 28×)

FIGS. *1, 8, 19—Idiognathodus antiquus* Stauffer and Plummer. *1, 8*, Oral and aboral views, Hushpuckney shale. Sample 1359 U. M.; specimen, Univ. Missouri C561-1). *19*, Oral view, Stark shale. (Sample 0108 E.; specimen, Univ. Missouri C197-5). (p. 136)

2, 4, 7, 10—Idiognathodus magnificus Stauffer and Plummer. *2*, Oral view, Lexington coal zone. (*Photographed by Burnley*) (Sample 1346–51 U. M.; specimen, Univ. Missouri C571-5). *4, 7*, Oral and lateral views, Cherokee shale. (Sample 0176 E.; specimen, Univ. Missouri C223-2). *10*, Oral view of senile specimen, Cherokee shale. (Sample 0117 E.; specimen, Univ. Missouri C217-1). (p. 135)

5, 6—Idiognathodus tersus Ellison, n. sp. Lateral and oral view of holotype, Heebner shale. (Sample 0097 E.; specimen, Univ. Missouri C252-3). (p. 134)

9, 13—Idiognathodus lobatus Gunnell. *9*, Oral view, Quivira shale. (Sample 1362 U. M.; specimen, Univ. Missouri C561-4). *13*, Oral view of one of the cotypes of *I. claviformis* Gunnell, Lexington coal zone. (Sample 1266 U. M.; specimen, Univ. Missouri C487-5). (p. 136)

11—Idiognathodus ? sp. Oral view Hushpuckney shale. (Sample 0017 E.; specimen, Univ. Missouri C252-5). (p. 137)

12, 14–18, 20, 21, 23—Idiognathodus claviformis Gunnell. *12*, Oral view of cotype (now the lectotype), Lexington coal zone. (Sample 1266 U. M.; specimen, Univ. Missouri C487-4). *14*, Oral view, Hushpuckney shale. (Sample 0155 E.; specimen, Univ. Missouri C248-5). *15, 18*, Oral and lateral views, Hushpuckney shale. (Sample 0140 E.; specimen, Univ. Missouri C205-4). *16*, Oral view, Quivira shale. (Sample 0107 E.; specimen, Univ. Missouri C233-5). *17, 20*, Oral and aboral view of a senile specimen, Bourbon formation. (Sample 1371 U. M.; specimen, Univ. Missouri C561-5). *21, 23*, Oral and aboral view of senile specimen, Hushpuckney shale. (Sample 1359 U. M.; specimen, Univ. Missouri C197-1). (p. 137)

22, 25—Idiognathodus acutus Ellison, n. sp. *22*, Oral view of holotype, Cherokee shale. (Sample 0117 E.; specimen, Univ. Missouri C308-4). *25*, Oral view, Cherokee shale. (Sample 0117 E.; specimen, Univ. Missouri C308-5). (p. 137)

24, 26–28—Gnathodus roundyi Gunnell. *24*, Lateral view, Cherokee shale. (Sample 0124 E.; specimen, Univ. Missouri C184-5). *26, 27*, Oral and aboral views, Cherokee shale. (Sample 0161 E.; specimen, Univ. Missouri C189-5). *28*, Lateral view, Cherokee shale. (Sample 0161 E.; specimen, Univ. Missouri C193-5). (p. 138)

STREPTOGNATHODUS EXCELSUS
Stauffer and Plummer
Plate 22, figures 15, 17, 20

Streptognathodus excelsus STAUFFER and PLUMMER, *1932*, Univ. Texas Bull., 3201, p. 48, pl. 4, figs. 2, 5.
Streptognathodus increbescens STAUFFER and PLUMMER, *1932*, idem., figs. 9, 15, 16.
Streptognathodus multinodosus GUNNELL, *1933*, Jour. Paleontology, vol. 7, p. 280, pl. 32, fig. 11.
Streptognathodus clavatulus GUNNELL, *1933*, idem., p. 280, pl. 31, fig. 9.
Streptognathodus subdivisis GUNNELL, *1933*, idem., p. 281, pl. 32, fig. 16.
Streptognathodus minutus GUNNELL, *1933*, idem., p. 282, pl. 32, fig. 65.
Streptognathodus chanutensis GUNNELL, *1933*, idem., p. 282, pl. 32, figs. 66, 67, 68.
Streptognathodus clarki GUNNELL, *1933*, idem., p. 283, pl. 33, fig. 3.

Outline of platform in oral view long, stout, lanceolate, posteriorly pointed, greatest width near the anterior one-third; accessory lobes on both sides, inner lobe larger; surface of lobes nodose or ridged, number of nodes varies from two to 15; transverse section of oral surface deeply concave; oral surface ornamented with 10 or more parallel transverse ridges obsolescent toward the deep median trough; blade of average length consisting of 10 to 25 denticles continued posteriorly as a carina in the oral trough for about one-third the length of the platform; carina may continue posteriorly in the trough as a row of nodes regularly spaced in alignment with the transverse ridges; carina set off from platform on both sides by sulci that merge into the trough posteriorly so that the lateral margins of the anterior portion of the platform extend as free edges.

Hypotypes.—Univ. of Missouri C560-2 (figured), C559-3 (figured), C263-4 (figured), C505-4 (G), C506-4 (G), C513-5 (G), C514-1 (G), C515-1 (G), and C491-1 (G).

Remarks.—Stauffer and Plummer's description of *Streptognathodus excelsus* was based on a senile specimen. As senility approaches, the oral trough tends to become shallow and the anterior free edges of the platform become fused with the blade. Some specimens show worn areas on the transverse ridges. The variability of the row of nodes in the oral trough is like that of *S. gracilis*.

This species differs from *S. gracilis* in that there is only one accessory lobe on the latter. *S. cancellosus* is very closely related but has a shallow, narrow oral groove rather than a true median trough.

Occurrence.—*Streptognathodus excelsus* is rare in the Des Moines and Virgil series but is very abundant in the Missouri series. The Graford and Mineral Wells formations of Texas are productive.

STREPTOGNATHODUS SULCATUS Gunnell
Plate 22, figures 8, 12

Streptognathodus sulcatus GUNNELL, *1933*, Jour. Paleontology, vol. 7, p. 281, pl. 32, fig. 10.
Streptognathodus ruidus GUNNELL, *1933*, idem., p. 281, pl. 32, fig. 17.

Outline of platform in oral view subelleptical, short, stout, posteriorly blunt, greatest width near midlength; accessory lobes on one or both sides consisting of only one or two nodes each; transverse section of oral surface deeply concave; oral surface ornamented with six to 15 parallel transverse ridges obsolescent toward the deep median trough and somewhat radiating posteriorly near the posterior end; blade longer than platform, consisting of six to 15 denticles continued posteriorly as a carina in the oral trough for about one-third the length of the platform; carina continued as a row of nodes in the trough; carina set off from the platform on either side by deep sulci that merge into the trough posteriorly so that the lateral margins of the anterior portion of the platform extend as free edges.

Types.—Holotype, Univ. of Missouri C505-3 (G). Hypotypes, C560-4 (figured), C224-4 (figured), and C506-5 (G).

Remarks.—The short platform and the rounded posterior end are distinctive of this species. It differs from *Streptognathodus elegantulus*, *S. gracilis*, and *S. excelsus* in that it lacks a pointed posterior end.

Occurrence.—*Streptognathodus sulcatus* is known only from the Hushpuckney shale (Swope limestone) and the Quindaro shale (Wyandotte limestone).

STREPTOGNATHODUS ELONGATUS Gunnell
Plate 22, figure 9

Streptognathodus elongatus GUNNELL, *1933*, Jour. Paleontology, vol. 7, p. 283, pl. 33, fig. 30.
Streptognathodus simplex GUNNELL, *1933*, idem., p. 285, pl. 33, fig. 40.

Outline of platform in oral view very long, slender, lanceolate, slightly flexed, posteriorly pointed, greatest width near midlength; if accessory lobe is present it commonly has only one or two nodes; transverse section of oral surface deeply V-shaped; oral surface ornamented with 10 or more parallel transverse ridges ending abruptly in the oral trough; blade of average length consisting of 10 to 18 denticles continued posteriorly as a carina in the oral trough for about one-fourth the length of the platform; row of nodes posterior to the carina generally absent; carina set off from platform on either side by deep sulci that merge into the trough posteriorly so that the lateral margins of the anterior portion of the platform extend as free edges.

Types.—Holotype, Univ. of Missouri C519-1 (G). Hypotypes, C264-4 (figured) and C521-1 (G).

Remarks.—This species differs from *Streptognathodus elegantulus* in that the latter is not so slender and the surface of the oral trough in the latter is U-shaped rather than V-shaped in transverse cross-section.

Occurrence.—*Streptognathodus elongatus* is very common in the shale beds associated with the Americus limestone and Hughes Creek shales of the Big Blue series and a few specimens are found in the Auburn shales of the Waubaunsee beds.

STREPTOGNATHODUS WABAUNSENSIS
Gunnell
Plate 22, figures 18, 19, 21, 22

Streptognathodus wabaunsensis GUNNELL, *1933*, Jour. Paleontology, vol. 7, p. 285, pl. 33, fig. 32.
Streptognathodus walteri GUNNELL, *1933*, idem., p. 284, pl. 33, fig. 31.
Streptognathodus acuminatus GUNNELL, *1933*, idem., p. 285, pl. 33, fig. 33.
Streptognathodus farmeri GUNNELL, *1933*, idem., p. 285, pl. 33, fig. 34.
Streptognathodus flangulatus GUNNELL, *1933*, idem., p. 285, pl. 33, fig. 35.

Outline of platform in oral view long, lanceolate, posteriorly pointed, greatest width near midlength; accessory lobe on one side only and situated far forward; surface of lobe nodose or ridged, nodes commonly not more than 10 in number; transverse section of oral surface flat to slightly concave having a shallow median trough; oral surface ornamented with eight to 15 parallel transverse ridges ending abruptly at the median trough and slightly radiating from the trough near the posterior end; blade of average length consisting of 10 to 16 denticles continued posteriorly on the anterior one-fourth of the platform as a low carina set off from the platform on either side by rapidly descending sulci so that the lateral margins of the anterior portion of the platform extend as free edges. Apron commonly widely flaring on outer side.

Types.—Holotype, Univ. of Missouri C519-3 (G). Hypotypes, C263-2 to 3 (figured), C263-5 (figured), C560-3 (figured), C519-2 (G), C519-4 to 5 (G), and C520-1 (G).

Remarks.—*Streptognathodus wabaunsensis* is noticeably different in that the oral trough is shallow and the one accessory lobe is situated farther anteriorly on the platform than in forms like *S. gracilis*.

Occurrence.—*Streptognathodus wabaunsensis* occurs in the beds from the Hushpuckney shale (Swope limestone) to the Big Blue series. It is most abundant in the Hughes Creek shale of the Big Blue series.

STREPTOGNATHODUS CANCELLOSUS
(Gunnell)
Plate 22, figures 23, 26

Idiognathodus cancellosus GUNNELL, *1933*, Jour. Paleontology, vol. 7, p. 270, pl. 31, fig. 10.
Idiognathodus regulatus GUNNELL, *1933*, idem., p. 272, pl. 31, fig. 24.
Idiognathodus binodosus GUNNELL, *1933*, idem., p. 274, pl. 31, fig. 35.
Idiognathodus biliratus GUNNELL, *1933*, idem., p. 276, pl. 31, fig. 59.
Idiognathodus symmetricus GUNNELL, *1933*, idem., p. 276, plate 32, fig. 3.
Idiognathodus simplex GUNNELL, *1933*, idem., p. 277, pl. 32, fig. 24.

Outline of platform in oral view, long, stout, lanceolate, posteriorly pointed, greatest width near anterior one-third; accessory lobes on both sides of platform, inner lobe larger; surface of lobes nodose or ridged, number of nodes varies from three to 15; transverse section of oral surface flat to slightly concave having a shallow median oral trough; oral surface ornamented with six to 18 parallel transverse ridges, normal or slightly oblique to the axis, ending abruptly at the median trough; commonly one or two of the ridges are complete from one margin of the platform to the other;

blade of average length consisting of 10 to 16 denticles continued posteriorly on the anterior one-third of platform as an aborted carina; carina may continue posteriorly as a row of nodes in the oral trough; carina set off from platform on either side by deep rapidly descending sulci so that the lateral margins of the anterior portion of the platform extend as free edges.

Types.—Holotype, Univ. of Missouri C491-2 (G). Hypotypes, C559-4 (figured), C257-4 (figured), C494-2 (G), C496-3 (G), C500-5 (G), C504-2 (G), and C507-2 (G).

Remarks.—The number of transverse ridges, the number of nodes on the accessory lobes, and the presence or absence of a row of nodes on the oral trough are variable. This species is distinguished from *Idiognathodus delicatus* and *I. magnificus* only by a shallow median oral groove. In form, this species is a transition from more typical streptognathodids to typical idiognathodids.

Occurrence.—*Streptognathodus cancellosus* is found in the Des Moines and Missouri series. It is not known above the Eudora shale (Stanton limestone).

STREPTOGNATHODUS OPPLETUS
Ellison, n. sp.
Plate 22, figures 13, 14, 16

Idiognathodus multinodosus GUNNELL, *1933*, Jour. Paleontology, vol. 7, p. 279, pl. 33, fig. 5.

Outline of platform in oral view, long slender, symmetrical and lanceolate, posteriorly pointed, greatest width near mid-length; accessory lobe poorly developed commonly consisting of a single node; transverse section nearly flat in posterior part of platform and concave in anterior portion; oral surface ornamented with six to 12 parallel transverse ridges obsolescent toward the median oral groove; blade of average length consisting of 10 to 16 denticles continued posteriorly as a prominent carina for one-half the length of platform; carina gradually gives way posteriorly to a row of nodes in alignment with transverse ridges; carina set off from platform by deep sulci on both sides so that the anterior margins of the platform extend as high free edges; both sulci continue posteriorly becoming shallow at the posterior end of carina; posterior half of platform commonly filled and transverse ridges may be complete from one margin to another.

Types.—Holotype, Univ. of Missouri C515-3 (figured, G). Paratypes, C264-2 (figured) and C234-1 (figured).

Remarks.—This species is distinguished by the prominent carina and the filled posterior half of the platform. It differs from *Streptognathodus elegantulus* in that the latter does not have the prominent carina, the filled posterior portion of the platform, and the high anterior free edges of the platform. *S. cancellosus* differs in that it has well developed accessory lobes. The name *multinodosus* is preoccupied.

Occurrence.—*Streptognathodus oppletus* is known from the Cherokee shale to the Eudora shale (Stanton limestone). It is very abundant in the Eudora shale.

STREPTOGNATHODUS ECCENTRICUS
Ellison, n. sp.
Plate 22, figure 24

Outline of platform in oral view, long, slender, lanceolate, asymmetrical, posteriorly pointed, greatest width near anterior one-third, accessory lobes on both sides, inner lobe larger; surface of lobes nodose, number of nodes varies from two to 10; transverse section of oral surface concave; oral surface bearing a shallow longitudinal trough parallel and on the inner side of the median line; oral surface ornamented with six to 18 parallel transverse ridges, ending abruptly in the trough and slightly radiating from the trough in the posterior portion of the platform; blade of average length consisting of 10 to 16 denticles continued posteriorly as a carina on the anterior one-third of platform; carina ends abruptly against a transverse ridge and is set off from the platform on either side by deep sulci so that the lateral margins of the anterior portion of the platform extend as free edges; sulcus on inner side continuous posteriorly into the eccentric oral trough.

Holotype.—Univ. of Missouri C560-1 (figured).

Remarks.—This species is remarkably constant, having as its only variables the number of nodes on the accessory lobes and the number of parallel transverse ridges. It differs from *Streptognathodus excelsus* in that the oral trough of the latter is median rather

than eccentric. It differs from *S. simulator* in that in the latter there is but one accessory lobe.

Occurrence.—*Streptognathodus eccentricus* is known from the Hushpuckney shale (Swope limestone) to the Heebner shale (Oread limestone) but is most common in the Eudora shale (Stanton limestone) and the Heebner shale.

STREPTOGNATHODUS SIMULATOR
Ellison n. sp.
Plate 22, figures 25, 27–30

Outline of platform in oral view long, slender, lanceolate, asymmetrical, posteriorly pointed, greatest width near anterior one-third; accessory lobe on inner side only and situated far forward; surface of lobe nodose or ridged, number of nodes varies from three to 10; transverse section of oral surface concave; oral surface bearing a shallow longitudinal trough parallel, but on the inner side of the median line; oral surface ornamented with six to 18 parallel transverse ridges, ending abruptly in the trough and slightly radiating from the trough in the posterior portion of the platform; some transverse ridges may completely bridge the trough; blade of average length consisting of 10 to 16 denticles continued posteriorly as a carina on the anterior one-fourth of platform; carina ends abruptly against a transverse ridge and is set off from the platform by deep sulci so that the lateral margins of the anterior portion of the platform extend as free edges, sulcus on inner side continuous posteriorly into the eccentric oral trough.

Types.—Holotype, Univ. of Missouri C257-5 (figured). Paratypes, C257-2 to 3 (figured), C256-5 (figured), and C255-5 (figured).

Remarks.—Some of the transverse ridges may coalesce from one side of the eccentric oral trough to the other. The number of nodes or ridges on the accessory lobe and the number of transverse platform ridges are the variables. This species differs from *Streptognathodus eccentricus* in that the latter has two accessory lobes. It differs from *S. cancellosus* and *S. wabaunsensis* in that the latter two have median oral troughs.

Occurrence.—*Streptognathodus simulator* is known from the Eudora shale (Stanton limestone) to the Big Blue beds. It is very common in the Heebner shale (Oread limestone).

Genus IDIOGNATHODUS Gunnell, 1931

Idiognathodus GUNNELL, *1931*, Jour. Paleontology, vol. 5, p. 249; STAUFFER and PLUMMER, *1932*, Univ. Texas Bull., 3201, p. 44; GUNNELL, *1933*, Jour. Paleontology, vol. 7, p. 269.
Idiognathodus (in part) HARRIS and HOLLINGSWORTH, *1933*, Amer. Jour. Sci., 5th ser., vol. 25, p. 202.

Platform-like teeth; longitudinal axis in oral view straight or curved, in lateral view straight or arched; outline in oral view lanceolate and bilaterally subsymmetrical; posterior end of platform rounded or pointed; anterior end continued into a free median longitudinal blade, consisting of laterally compressed, partly coalesced, closely spaced, sharp-edged denticles with discrete termini, that may or may not be continued on to the platform as a median carina; oral surface of platform slightly convex, flat, or slightly concave in transverse section; oral surface bearing transverse ridges or rows of nodes that may or may not be continuous from one side of the platform to the other; longitudinal oral trough or groove lacking; nodose accessory lobes may or may not be extended laterally from one or both sides near the free lateral margins of the anterior part of the platform; inner anterior edge of platform coalesced with blade about two to three denticles anterior to that of outer edge.

Platform in lateral view broadly arched with greatest thickness near the anterior end, from which it is tapered gradually posteriorly to a blunt point and anteriorly to a thin edge which is coalesced with the low longitudinal divide on the lateral surface of the blade near the base of the denticles a short distance above the smooth sharp aboral edge of the blade; oral edge of platform crenulate because of the presence of nodes and transverse ridges; smooth lateral walls of the platform are vertical, sloping laterally, or overhanging, commonly forming a broad sweeping apron above the lateral edges of the attachment scar of the aboral surface.

Aboral surface of platform smooth and occupied entirely by a deeply excavated longitudinally elongate bilaterally asym-

metrical cup, pointed at one end and continued at the other end as a furrow along the aboral edge of the blade. Transverse section of cup is V-shaped in outline; lateral area of cup on inner side of the midline commonly widest at the anterior end and the posterior portion tapered and slender; lateral area of cup on outer side of the midline commonly widest about midlength and tapered regularly both anteriorly and posteriorly; surface of cup marked by fine concentric lines and low crenulations may radiate from the apex of the cup. For purposes of description the specimens are oriented as in the genus *Streptognathodus*.

Remarks.—*Idiognathodus* differs from *Streptognathodus* in that the latter possesses a longitudinal oral trough or groove. In all other features these two genera are alike. *Idiognathodus* differs from *Polygnathodella* Harlton in that the blade of the latter is not median.

IDIOGNATHODUS TERSUS Ellison n. sp.
Plate 23, figures 5, 6

Outline of platform in oral view, long, slender, lanceolate, posteriorly pointed, greatest width near midlength; no accessory lobes; transverse section of oral surface flat to slightly concave; oral surface ornamented with six to 15 parallel transverse ridges complete from one margin to another, normal or slightly oblique to the axis; blade of average length consisting of 10 or more denticles continued posteriorly on the anterior one-fourth of platform as a carina; carina ends abruptly against a transverse ridge; carina set off from platform by deep sulci on both sides so that the lateral margins of the anterior portion of platform extend as free edges. Sulci end abruptly posteriorly against the first complete transverse ridge.

Holotype.—Univ. of Missouri C252-3 (figured).

Remarks.—This species differs from *Idiognathodus delicatus* and *I. magnificus* in that the latter two have accessory lobes.

Occurrence.—*Idiognathodus tersus* is known from the Muncie Creek shale (Iola limestone) to the Queen-Hill shale (Lecompton limestone).

IDIOGNATHODUS DELICATUS Gunnell
Plate 22, figures 31–36

Idiognathodus delicatus GUNNELL, *1931*, Jour. Paleontology, vol. 5, p. 250, pl. 29, figs. 23, 24, 25; STAUFFER and PLUMMER, *1932*, Univ. Texas Bull., 3201, p. 45, pl. 4, figs. 4, 21, 24, 25, 26.

Idiognathodus magnificus STAUFFER and PLUMMER, *1932*, Univ. Texas Bull., 3201, p. 46, pl. 4, fig. 19, not figs. 8, 18, 20.

Idiognathodus modulatus GUNNELL, *1933*, idem., p. 271, pl. 31, fig. 15.

Idiognathodus spathodus GUNNELL, *1933*, idem., p. 273, pl. 31, fig. 28.

Idiognathodus semipapulatus GUNNELL, *1933*, idem., p. 273, pl. 31, figs. 29, 50.

Idiognathodus lanceolatus GUNNELL, *1933*, idem., p. 273, pl. 31, figs. 31, 32.

Idiognathodus folium GUNNELL, *1933*, idem., p. 274, pl. 31, fig. 33.

Idiognathodus gemmiformis GUNNELL, *1933*, idem., p. 274, pl. 31, fig. 44.

Idiognathodus warei GUNNELL, *1933*, idem., p. 279, pl. 32, figs. 59, 60, 61.

Idiognathodus kansensis GUNNELL, *1933*, idem., p. 279, pl. 32, figs. 62, 63, 64.

Idiognathodus cherryvalensis GUNNELL, *1933*, idem., p. 277, pl. 32, fig. 5.

Idiognathodus corrugatus GUNNELL, *1933*, idem., p. 277, pl. 32, fig. 6, not fig. 7.

Outline of platform in oral view long, slender lanceolate, posteriorly pointed, greatest width near anterior one-third; accessory lobes on both sides of platform, inner lobe larger, surface of lobes nodose, number of nodes varies from one to 20 on each lobe; transverse section of oral surface flat to slightly concave; oral surface ornamented with six to 18 parallel transverse ridges, normal or slightly inclined to the axis, complete and extended from one margin to another; blade of average length consisting of 10 to 16 denticles continued posteriorly on the anterior one-third of platform as an aborted carina, set off from the platform on either side by deep rapidly descending sulci so that the lateral margins of the anterior portion of the platform extend as free edges.

Types.—Holotype, Univ. of Missouri C488-1 (G). Hypotypes, C252-4 (figured), C248-3 (figured), C234-2 (figured), C561-2 to 3 (figured), C492-3 (G), C495-1 to 2 (G), C495-4 (G), C496-1 (G), C498-2 (G), C513-3 to 4 (G), C504-5 (G), C569-2 to 3 (B), and C573-1 (B).

Remarks.—The number of transverse ridges and the number of nodes on each accessory lobe are variable. In immature forms the number of transverse ridges is less than 10 and the number of nodes on the lobes may be only one or two. These increase, in mature forms, to about 12 transverse ridges

and about five to 10 nodes on each lobe. The transverse section of the oral surface may be slightly concave and a faint trace of a longitudinal oral groove may be present on the anterior portion of the platform.

The redescription of this species is designed to include all of the forms with a nodose accessory lobe on both sides of the platform except *Idiognathodus magnificus*, *I. lobatus*, and *I. claviformis*. *I. magnificus* has a relatively wider platform and the outer accessory lobe is not set off distinctly from the main body of the platform, as it is in *I. delicatus*. *I. claviformis* has a rounded posterior end and the transverse ridges are not continuous from one margin to the other as they are in *I. delicatus*. The extreme stubbiness and relatively great width of the platform of *I. lobatus* distinguishes it from *I. delicatus*.

Occurrence.—*Idiognathodus delicatus* is abundant in beds from the Cherokee shale to the Eudora shale (Stanton limestone). The Mineral Wells and Graford formations of Texas yield this species.

IDIOGNATHODUS MAGNIFICUS
Stauffer and Plummer
Plate 23, figures 2, 4, 7, 10

Idiognathodus magnificus STAUFFER and PLUMMER, *1932*, Univ. Texas Bull., 3201, p. 46, pl. 4, figs. 8, 18, 20, not fig. 19.
Idiognathodus pustulata HARRIS and HOLLINGSWORTH, *1933*, Amer. Jour. Sci., 5th ser., vol. 25, p. 204, pl. 1, fig. 11.
Idiognathodus cuneiformis GUNNELL, *1933*, Jour. Paleontology, vol. 7, p. 270, pl. 31, fig. 8.
Idiognathodus harkeyi GUNNELL, *1933*, idem., p. 270, pl. 31, fig. 11.
Idiognathodus siculus GUNNELL, *1933*, idem., p. 271, pl. 31, fig. 14.
Idiognathodus sulciferous GUNNELL, *1933*, idem., p. 271, pl. 31, fig. 16.
Idiognathodus clavatus GUNNELL, *1933*, idem., p. 271, pl. 31, fig. 19.
Idiognathodus ruidus GUNNELL, *1933*, idem., p. 272, pl. 31, fig. 25.
Idiognathodus megistus GUNNELL, *1933*, idem., p. 273, pl. 31, fig. 30.
Idiognathodus cicatricosus GUNNELL, *1933*, idem., p. 274, pl. 31, fig. 34.
Idiognathodus wintersetensis GUNNELL, *1933*, idem., p. 274, pl. 31, figs. 36, 51.
Idiognathodus strigillatus GUNNELL, *1933*, idem., p. 274, pl. 31, fig. 37; pl. 32, fig. 8.
Idiognathodus fusiformis GUNNELL, *1933*, idem., p. 276, pl. 31, fig. 49.
Idiognathodus vadosus GUNNELL, *1933*, idem., p. 275, pl. 31, fig. 45.
Idiognathodus erodus GUNNELL, *1933*, idem., p. 275, pl. 31, fig. 48.
Idiognathodus walteri GUNNELL, *1933*, idem., p. 277, pl. 32, fig. 9.

Outline of platform in oral view, long, and stout, posteriorly pointed, greatest width near anterior one-third; accessory lobes on both sides of platform, inner lobe larger, outer lobe noticeably fused into main body of platform, surface of lobes nodose and ridged, making innumerable patterns of intricate design, generally different for each specimen; transverse section of oral surface flat to slightly concave; oral surface ornamented with seven to 20 parallel ridges, normal or oblique to the axis, complete, and extended from one margin to the other; commonly bizarre designs are produced by the irregular fusion of these ridges.

Blade of average length consisting of 10 to 18 denticles continued posteriorly as an aborted carina, set off from the platform on either side by deep rapidly descending sulci so that the lateral margins of the anterior portion of the platform extend as free edges. Lateral surface of platform bulging, rounded and commonly extended beyond the outline of the oral surface.

Hypotypes.—Univ. of Missouri C223-2 (figured), C571-5 (figured, B), C217-1 (figured), C490-5 (G), C491-3 (G), C492-2 (G), C492-4 (G), C493-2 (G), C494-3 (G), C495-3 (G), C496-4 to 5 (G), C499-1 to 2 (G), C499-4 (G), C498-3 (G), and C505-2 (G).

Remarks.—This is probably one of the most variable species of *Idiognathodus* because the oral ornamentation of no two specimens is alike. The accessory lobes may be ridged or nodose. The carina is prominent in some specimens and practically absent in others. Many show evidences of wear to the extent that the design of ridges and nodes on portions of the platform has disappeared. This species may represent senile forms of *Idiognathodus delicatus*.

The Oklahoma specimen (*Idiognathodus pustulata*) here included in the synonymy of *I. magnificus* shows clearly how trituration of three simple anterior longitudinal platform ridges gives the appearance of six ridges as described by Harris and Hollingsworth.

Idiognathodus magnificus differs from *I.*

delicatus in that the latter is smaller, more slender, and bears lobes that are set off clearly from the main body of the platform. *I. claviformis* differs from *I. magnificus* in that ridges on the latter are complete from one margin to the other and the posterior end is pointed.

Occurrence.—*Idiognathodus magnificus* is very common in the Des Moines and Missouri series. The species is known in the Graford and Mineral Wells formations of Texas and the Boggy formation of Oklahoma.

IDIOGNATHODUS ANTIQUUS Stauffer and Plummer
Plate 23, figures 1, 8, 19

Idiognathodus antiquus STAUFFER and PLUMMER, *1932*, Univ. Texas Bull., 3201, p. 44, pl. 4, fig. 17.
Idiognathodus porcatus GUNNELL, *1933*, Jour. Paleontology, vol. 7, p. 272, pl. 31, fig. 21.
Idiognathodus chiriformis GUNNELL, *1933*, idem., vol. 7, p. 272, pl. 31, fig. 23.
Idiognathodus liratus GUNNELL, *1933*, idem., p. 273, pl. 31, fig. 27.
Idiognathodus corrugatus GUNNELL, *1933*, idem., p. 277, pl. 32, fig. 7, not fig. 6.

Outline of platform in oral view long, stout, posteriorly pointed, greatest width near anterior one-third; accessory lobe on inside only; surface of lobe nodose; transverse section of oral surface flat to slightly concave; oral surface ornamented with 10 to 18 broadly sinuous transverse ridges variably inclined to the axis, and complete from one margin to another; blade of average length consisting of 10 to 18 denticles and continued posteriorly on the platform as a very short carina; rapidly descending sulcus commonly present only on the inside of anterior end of platform; outside fused with blade making no anterior free edge.

Hypotypes.—Univ. of Missouri C561-1 (figured), C197-5 (figured), C493-4 (G), C495-1 (G), C494-5 (G), and C504-5 (G).

Remarks.—The only feature of great variation is the design of the oral ridges and nodes. Otherwise the species is remarkably uniform. This species differs from *Idiognathodus magnificus* in that the latter has an accessory lobe on both sides of the platform and both sides of the anterior end of the platform are extended into free edges being separated from the carina by deep sulci.

Occurrence.—*Idiognathodus antiquus* is known from the Cherokee shale to the Quindaro shale (Wyandotte limestone). It is very abundant in the Hushpuckney and Stark shales of the Bronson group. The Mineral Wells formation of Texas yields this species.

IDIOGNATHODUS LOBATUS Gunnell
Plate 23, figures 9, 13

Idiognathodus lobatus GUNNELL, *1933*, Jour. Paleontology, vol. 7, p. 271, pl. 31, figs. 17, 18.
Idiognathodus claviformis GUNNELL, *1931*, idem., vol. 5, p. 249, pl. 29, fig. 22, not fig. 21.
Idiognathodus rotundus GUNNELL, *1933*, idem., vol. 7, p. 277, pl. 32, fig. 4.
Idiognathodus farrelli GUNNELL, *1933*, idem., p. 279, pl. 33, fig. 4.

Outline of platform in oral view subelliptical, stubby, stout, posteriorly rounded, greatest width near the anterior one-third; accessory lobes on both sides of platform, inner lobe larger; surface of lobes nodose, number of nodes varies from one to 10 on each lobe; transverse section of oral surface flat to slightly concave; oral surface ornamented with eight to 15 parallel transverse ridges, commonly curved, normal or oblique to the axis, complete and extended from one margin to another; blade unusually long consisting of 12 to 20 denticles and continued posteriorly as an aborted carina set off from the platform by deep rapidly descending sulci so that the lateral margins of the anterior portion of the platform extend as free edges.

Types.—Holotype, Univ. of Missouri C492-5 (G). Hypotypes, C561-4 (figured), C487-5 (figured), C504-3 (G), and C515-2 (G).

Remarks.—The most variable part of this species is the amount of lateral extension of the lobes and the nature of the oral design made by the ridges. Peculiarly, some of the transverse ridges bifurcate and nearly all of them have a broad sinuosity. This species differs from *Idiognathodus delicatus* and *I. magnificus* in that it has a relatively short platform and a blunt posterior end. It differs from *I. claviformis* in that the transverse ridges of the latter are not complete from one margin to the other.

Occurrence.—*Idiognathodus lobatus* is known from the Hushpuckney shale to the Eudora shale of the Missouri series.

IDIOGNATHODUS CLAVIFORMIS
Gunnell
Plate 23, figures 12, 14–18, 20, 21, 23

Idiognathodus claviformis GUNNELL, *1931*, Jour. Paleontology, vol. 5, p. 249, pl. 29, fig. 21, not fig. 22; STAUFFER and PLUMMER, *1932*, Univ. Texas Bull., 3201, p. 45.
Idiognathodus fustiformis GUNNELL, *1933*, Jour. Paleontology, vol. 7, p. 269, pl. 31, fig. 7.
Idiognathodus nodostriatus GUNNELL, *1933*, idem., p. 272, pl. 31, fig. 20.

Outline of platform in oral view broad, stout, lanceolate, posteriorly rounded, greatest width near anterior one-third; accessory lobes on both sides of platform, inner lobe larger; surface of lobes nodose, nodes vary from six to 25 on each lobe; transverse section of oral surface flat to slightly convex; oral surface ornamented with discontinuous transverse ridges with a variable number of irregularly spaced nodes; margins of platform commonly well rounded; blade of average length consisting of 10 to 16 denticles continued only a short distance posteriorly on the platform as a carina; carina may or may not be set off from anterior edges of platform by sulci; aboral cup commonly ornamented with well defined radiating undulations.

Types.—Genolectotype, Univ. of Missouri C487-4 (figured, G). Hypotypes, C233-5 (figured), C205-4 (figured), C561-5 (figured), C197-1 (figured), C248-5 (figured), C490-3 (G), and C493-3 (G).

Remarks.—Two specimens were designated as syntypes of this species which, when cleaned, have little resemblance to each other. One of these (no. C487-5, plate 23, figure 13) resembles closely the type specimens of *Idiognathodus lobatus* Gunnell and, therefore, is transferred to that species. The other syntype (now the lectotype) of *I. claviformis* (no. C487-4, plate 23, figure 12) is clearly highly modified by senility and, therefore, is misleading in the characteristics of the species. In redefining this form the above description is based on normal mature specimens that fit most nearly the probable normal development of *I. claviformis* and the genotype characters have not been changed.

This species is one of the largest and most massive of all conodonts. Except for the great variability of the oral ornamentation, the rotund, stout appearance is rather constant. This species differs from *Idiognathodus delicatus*, *I. magnificus*, and *I. lobatus* in that the transverse oral ridges are discontinuous and the margins of the platform are well rounded.

Occurrence.—*Idiognathodus claviformis* occurs in the Des Moines and Missouri series. It is not known above the Quivira shale. It is also known from the Mineral Wells formation of Texas.

IDIOGNATHODUS ACUTUS
Ellison, n. sp.
Plate 23, figures 22, 25

Outline of platform in oral view wedge-shaped, long, slender, posteriorly acutely pointed, greatest width near anterior one-fourth; lateral margins of oral outline nearly straight; accessory lobes on both sides of platform, inner lobe larger, both more or less fused into main body of platform; surface of lobes nodose and ridged, making innumerable patterns of intricate design, generally radial in nature; transverse section of oral surface flat to slightly concave; oral surface ornamented with 10 or more parallel ridges, normal or oblique to the axis, and may or may not be complete from one margin to another.

Blade of average length, consisting of 10 to 18 denticles continued posteriorly as an aborted carina; shallow sulci set off the anterior portion of platform as free edges. Lateral surface bulging, rounded, and extended beyond outline of oral surface.

Types.—Holotype, Univ. of Missouri C308-4 (figured). Paratype, C308-5 (figured).

Remarks.—This is a very elongate idiognathodid. The posteriorly acutely pointed wedge-shaped outline distinguishes it from *Idiognathodus magnificus*.

Occurrence.—*Idiognathodus acutus* is known only from the Des Moines series. The species is particularly abundant in the upper Cherokee shale.

IDIOGNATHODUS ? sp.
Plate 23, figure 11

Outline of platform in oral view long, broad, symmetrical, lanceolate, posteriorly pointed, greatest width near midlength; no accessory lobes; transverse section flat to concave; oral surface ornamented with more

than 12 parallel transverse ridges; blade broken but continued posteriorly as a prominent carina for one-half the length of the platform; carina gradually gives way posteriorly to a row of nodes in alignment with transverse ridges; carina set off by shallow sulci on both sides; posterior half of platform commonly filled, and many of the transverse ridges are completed from one margin to another.

Figured specimen, Univ. of Missouri C252-5.

Remarks.—This form is too poorly represented in the collection to make certain the specific reference. It has much in common with *Streptognathodus oppletus* and may represent the senile stage. On the other hand, it may be a pathological specimen of some other species, or the normal development of a new species.

Occurrence.—The figured specimen is from the Hushpuckney shale (Swope limestone).

Genus GNATHODUS Pander 1856

GNATHODUS ROUNDYI Gunnell
Plate 23, figures 24, 26–28

Gnathodus roundyi GUNNELL, *1931*, Jour. Paleontology, vol. 5, p. 249, pl. 29, figs. 19, 20. STAUFFER and PLUMMER, *1932*, Univ. Texas Bull., 3201, p. 41.

Outline of platform in oral view long, slender, lanceolate, greatest width near anterior one-third; inner side of platform transversely concave bearing five to ten transverse parallel ridges and nodes obsolescent toward the carina; outer side of platform bearing a posteriorly converging row of one to four nodes on a smooth expanding apron; blade about one and one-half times the length of the platform and consisting of 10 to 20 denticles continued posteriorly as a carina the full length of the platform; carina set off from platform by sulcus on inner side only.

Types.—Holotype, Univ. of Missouri C487-3 (G). Hypotypes, C193-5 (figured), C189-5 (figured), C184-5 (figured), and C570-2 (B).

Remarks.—This species differs from *Gnathodus dilatus* Stauffer and Plummer in that the latter lacks any platform nodes on the outer side.

Occurrence.—All of the conodont-bearing zones of the Des Moines series in Missouri and Kansas yield this species. The Mineral Wells formation of Texas is productive.

SPECIMENS INDETERMINABLE
Plate 20, figure 28

Many fragments of denticulate bars are found which may actually belong to any one of several genera such as *Lonchodina*, *Prioniodina*, *Prioniodus*, *Hibbardella*, and *Ligonodina*. Material is not adequate to properly classify these forms, nor to make correct synonymies.

The following list of specimens figured by Gunnell belongs to this indeterminable category:

Lonchodus simplex GUNNELL, *1931*, Jour. Paleontology, vol. 5, p. 248, pl. 29, figs. 13, 14; ——, *1933*, idem., vol. 7, p. 269, p. 31, fig. 2.
Lonchodus confluens GUNNELL, *1931*, idem., vol. 5, p. 248, pl. 29, fig. 17.
Lonchodina sp. GUNNELL, *1931*, idem., p. 248, pl. 29, figs. 15, 16; ——, *1931*, idem., p. 248, pl. 29, fig. 18; ——, *1933*, idem., vol. 7, p. 269, pl. 31, fig. 3; ——, *1933*, idem., p. 269, pl. 32, figs. 40, 41. 42.
Prioniodina sp. GUNNELL, *1931*, idem., vol. 5, p. 249, pl. 29, fig. 27.
Lonchodus sp. GUNNELL, *1933*, idem., vol. 7, p. 269, pl. 32, fig. 38.
Subprioniodina sp. GUNNELL, *1933*, idem., p. 267, pl. 32, fig. 33; ——, *1933*, idem., p. 267, pl. 33, figs. 19, 27.
Euprioniodina sp. GUNNELL, *1933*, idem., p. 269, pl. 33, fig. 24.

INVALID GENERIC NAME

Idioprioniodus GUNNELL, *1933*, Jour. Paleontology, vol. 7, p. 265. *Genotype: Idioprioniodus typus* Gunnell.

The genotype is now placed in synonymy with *Ligonodina typa* (Gunnell). *Idioprioniodus camerus* Gunnell is the same as *Ligonodina lexingtonensis* (Gunnell). *Idioprioniodus striatus* Gunnell is synonymous with *Hibbardella subacoda* (Gunnell).

LIST OF SAMPLES

Samples designated by U. M. are from the University of Missouri collections. Those designated by E. are from the Ellison collections, which are at the University of Missouri.

Des Moines series.—0174 E. Below the Ardmore limestone (Cherokee shale) at the Brick Plant, Sec. 8, T. 48 N., R. 13 W., Columbia, Boone County, Missouri. Coll., S. Ellison.

717 U. M. Same as above. Coll., John Roberts.

0122 E. Above and below the Ardmore limestone (Cherokee shale) 6.5 miles north of Columbia on U. S. highway 63, Sec. 35, T. 50 N., R. 13 W., Boone County, Missouri. Coll., S. Ellison.

1102 U. M. Below the Ardmore limestone (Cherokee shale) in the Brady Mine sump 2 miles southwest of Moberly, Secs. 10, 11, T. 53 N., R. 14 W., Randolph County, Missouri. Coll., J. D. Davies.

1145 U. M. Below the Ardmore (?) limestone (Cherokee shale) 9 miles south of Ft. Scott on U. S. highway 73E, Sec. 20, T. 27 S., R. 25 E., Bourbon County, Kansas. Coll., John Roberts and M. G. Mehl.

0109 E. Below the lower Ft. Scott limestone 8 miles east of Nowata on U. S. highway 60, Sec. 34, T. 26 N., R. 17 E., Nowata County, Oklahoma. Coll., S. Ellison and W. C. Warner.

0117 E. Below the lower Ft. Scott limestone 2 miles northeast of Harrisburg, Sec. 1, T. 50 N., R. 14 W., Boone County, Missouri. Coll., S. Ellison.

0118 E. Below the lower Ft. Scott limestone 11 miles north of Columbia on U. S. highway 63, Sec. 13, T. 50 N., R. 13 W., Boone County, Missouri. Coll., S. Ellison.

0123 E. Below the lower Ft. Scott limestone 5 miles north of Columbia on U. S. highway 63, Sec. 24, T. 49 N., R. 13 W., Boone County, Missouri. Coll., S. Ellison.

0158 E. Top of the Cherokee shale 5 miles southwest of Fulton on U. S. highway 54, Sec. 2 T. 48 N., R. 10 W., Callaway County, Missouri. Coll., S. Ellison.

680 U. M. Same as above, Coll., M. G. Mehl.

0159 E. Top of the Cherokee shale 1 mile south of Harg, Sec. 24, T. 48 N., R. 12 W., Boone County, Missouri. Coll., S. Ellison.

0175 E. Mulky coal zone at the Brick Plant in Columbia, Sec. 8, T. 48 N., R. 13 W., Boone County, Missouri. Coll., S. Ellison.

0176 E. Same as above but one foot higher.

716 U. M. Same as 0175 E. Coll., John Roberts.

1142 U. M. Shale partings in the lower Ft. Scott limestone 17.5 miles south of Ft. Scott on U. S. highway 73E, Sec. 8, T. 28 S., R. 25 E., Bourbon County, Kansas. Coll., John Roberts and M. G. Mehl.

1038 U. M. Shale partings in tilted Ft. Scott (?) limestone near Gillaspie School, Sec. 26, T. 49 N., R. 12 W., Boone County, Missouri. Coll., M. G. Mehl.

682 U. M. Shale partings in the Ft. Scott (?) limestone near Dixie, Sec. 12, T. 46 N., R. 10 W., Callaway County, Missouri. Coll., M. G. Mehl.

967 U. M. Shale partings in the Ft. Scott (?) limestone 0.5 mile north of Gillaspie School, Sec. 26, T. 49 N., R. 12 W., Boone County, Missouri. Coll., M. G. Mehl.

672 U. M. Below upper Ft. Scott limestone south of Hinkson Creek, SE ¼ of Sec. 27, T. 49 N., R. 12 W., Boone County, Missouri. Coll., M. G. Mehl.

683 U. M. Shale partings in Ft. Scott (?) limestone near Dixie, Sec. 12, T. 46 N., R. 10 W., Callaway County, Missouri. Coll., M. G. Mehl.

1027 U. M. Summit coal zone in tilted area near Gillaspie School, Sec. 26, T. 49 N., R. 12 W., Boone County, Missouri. Coll., M. G. Mehl.

1138 U. M. Below upper Ft. Scott limestone 20 miles south of Ft. Scott on U. S. Highway 73E, Sec. 29, T. 28 S., R. 25 E., Crawford County, Kansas. Coll., John Roberts and M. G. Mehl.

0124 E. Between lower and upper Ft. Scott limestone 5 miles north of Columbia on U. S. highway 63, Sec. 24, T. 49 N., R. 13 W., Boone County, Missouri. Coll., S. Ellison.

0120 E. Below the upper Ft. Scott limestone 1 mile west of U. S. highway 63 on Missouri highway 124, Sec. 11, T. 50 N., R. 13 W., Boone County, Missouri. Coll., S. Ellison.

0161 E. Below the upper Ft. Scott limestone 4.5 miles northeast of Columbia, Secs. 33, 34, T. 49 N., R. 12 W., Boone County, Missouri. Coll., S. Ellison.

675 U. M. Shale parting in upper Ft. Scott limestone. Same locality as above. Coll., M. G. Mehl.

389 U. M. Shale parting in upper Ft. Scott limestone near Dixie, Sec. 12, T. 46 N., R. 10 W., Callaway County, Missouri. Coll., M. G. Mehl.

0086 E. Lexington coal zone 6 miles west of Oswego, Sec. 3, T. 33 S., R. 20 E., Labette

County, Kansas. Coll., C. C. Branson and S. Ellison.

0110 E. Lexington coal zone 8 miles east of Nowata on U. S. highway 60, Sec. 34, T. 26 N., R. 17 E., Nowata County, Oklahoma. Coll., S. Ellison and W. C. Warner.

1346-51 U. M. Lexington coal zone. Several localities in Lexington and southwest of Lexington, Secs. 32, 33, T. 51 N., R. 27 W., and Secs. 5, 6, T. 50 N., R. 27 W., Lafayette County, Missouri. Coll., Gertrude I. Burnley. (Material used as a Master's thesis at the University of Missouri 1938).

1266 U. M. Lexington coal zone (Not Cherokee) on the north bluff in the town of Lexington, Sec. 33, T. 51 N., R. 27 W., Lafayette County, Missouri. Coll., F. H. Gunnell. Same as 1286 U. M. later described by Gunnell as locality 1.

0104 E. Above the Pawnee limestone 2 miles east of Koodie's Bluff on U. S. highway 60, Sec. 33, T. 26 N., R. 17 E., Nowata County, Oklahoma. Coll., S. Ellison and W. C. Warner.

0111 E. Below the Altamont limestone 0.5 mile west of Koodie's Bluff on U. S. highway 60, Sec. 34, T. 26 N., R. 16 E., Nowata County, Oklahoma. Coll., W. C. Warner.

Missouri series.—1371 U. M. Below Wayside sandstone and above nodular limestone of the lower Bourbon formation at Sni Mills, Sec. 28, T. 48 N., R. 29 W., Jackson County, Missouri. Coll., S. Ellison.

0162 E. Top of the Bourbon shale at U. S. highway 71 and Blue river road, Sec. 14, T. 48 N., R. 33 W., Jackson County, Missouri. Coll., S. Ellison. Same as 1378 U. M.

0127 E. Top of the Bourbon shale at Cement City, Sec. 22, T. 50 N., R. 32 W., Jackson County, Missouri. Coll., S. Ellison. Same as 1355 U. M.

0138 E. Top of the Bourbon shale at 63rd street and Kansas City Southern Railroad, Sec. 1, T. 48 N., R. 33 W., Jackson County, Missouri. Coll., S. Ellison. Same as 1378 U. M.

1359 U. M. Hushpuckney shale on Rock Island Railroad 0.5 mile north of Knobtown, Sec. 14, T. 48 N., R. 32 W., Jackson County, Missouri. Coll., S. Ellison.

0140 E. Hushpuckney shale. Same locality as 0138 E. above. Coll., S. Ellison.

0155 E. Hushpuckney shale 0.5 mile south of Little Blue, Sec. 14, T. 48 N., R. 32 W., Jackson County, Missouri. Coll., S. Ellison.

0116 E. Hushpuckney shale 0.75 mile south of the Smith Farm on Blue River road, Sec. 9, T. 47 N., R. 33 W., Jackson County, Missouri. Coll., S. Ellison. Same as 1362 U. M.

0149 E. Hushpuckney shale on U. S. highway 50 and Blue River, Sec. 26, T. 49 N., R. 33 W., Jackson County, Missouri. Coll., S. Ellison. Same as 1376 U. M.

0017 E. Hushpuckney shale 1 mile south of U. S. highway 40 on Noland road, Sec. 35, T. 49 N., R. 32 W., Jackson County, Missouri. Coll., S. Ellison. Same as 1356 U. M.

1280 U. M. Stark shale in quarry east of Leeds, Sec. 24, T. 49 N., R. 33 W., Kansas City, Jackson County, Missouri. Coll., F. H. Gunnell. Same as Gunnell's locality 2 and 1370 U. M.

1267 U. M. Stark shale at 29th street and Southwest boulevard, Kansas City, Sec. 17, T. 49 N., R. 33 W., Jackson County, Missouri. Coll., F. H. Gunnell. Same as Gunnell's locality 5 and 1369 U. M.

348 U. M. Stark shale 3.25 miles north of Excelsior Springs on U. S. highway 69, Sec. 24, T. 53 N., R. 30 W., Clay County, Missouri. Coll., R. E. Peck.

0141 E. Stark shale at 48th street and Prospect avenue, Kansas City, Sec. 24, T. 49 N., R. 33 W., Jackson County, Missouri. Coll., S. Ellison. Same as 1377 U. M.

0142 E. Same as above.

0151 E. Stark shale 0.5 mile east of Morris, Sec. 27, T. 11 S., R. 24 E., Wyandotte County, Kansas. Coll., S. Ellison.

0115 E. Stark shale 0.75 mile south of Smith Farm on Blue River road, Sec. 9, T. 47 N., R 33 W., Jackson County, Missouri. Coll., S. Ellison. Same as 1363 U. M.

0108 E. Stark shale 1.5 miles north of Little Blue, Sec. 2, T. 48 N., R. 32 W., Jackson County, Missouri. Coll., S. Ellison.

1352 U. M. Shale partings in basal Winterset limestone at U. S. highway 50 and Kansas City Southern Railroad in Eastwood Hills, Sec. 25, T. 49 N., R. 33 W., Jackson County, Missouri. Coll., S. Ellison.

1281-82 U. M. Shale partings in basal Winterset limestone at 29th street and Southwest boulevard, Kansas City, Sec. 17, T. 49 N., R. 33 W., Jackson County, Mis-

souri. Coll., F. H. Gunnell. Same as Gunnell's locality 5 and 1369 U. M.

1268-72 U. M. Shale partings in basal Winterset limestone in quarry east of Leeds, Sec. 24, T. 49 N., R. 33 W., Kansas City, Jackson County, Missouri. Coll., F. H. Gunnell. Same as Gunnell's locality 2 and 1370 U. M.

0146 E. Shale parting in basal Winterset limestone at 29th street and Southwest boulevard, Kansas City, Sec. 17, T. 49 N., R. 33 W., Jackson County, Missouri. Coll., S. Ellison. Same as 1369 U. M.

1275-79 U. M. Wea shale (called Cherryvale by Gunnell) at 12th street and West Bluff, Kansas City, Sec. 5, T. 49 N., R. 33 W., Jackson County, Missouri. Coll., F. H. Gunnell. Same as Gunnell's locality 4.

0101 E. Wea shale at Cement City, Sec. 22, T. 50 N., R. 32 W., Jackson County, Missouri. Coll., S. Ellison. Same as 1355 U. M.

0143 E. Wea shale at 75th street and Kansas City Southern Railroad, Sec. 12, T. 48 N., R. 33 W., Jackson County, Missouri. Coll., S. Ellison.

1362 U. M. Quivira shale at 110th street and Topping avenue 0.5 mile east of Smith Farm, Sec. 3, T. 47 N., R. 33 W., Jackson County, Missouri. Coll., S. Ellison.

0107 E. Same as above. Coll., W. C. Warner and S. Ellison.

1283 U. M. Quivira shale at Duntile's quarry, Sec. 17, T. 49 N., R. 33 W., Kansas City, Jackson County, Missouri. Coll., F. H. Gunnell. Gunnell's locality 6.

1273 U. M. Quivira shale in the Main street cut south of the Kansas City Union Station, Sec. 8, T. 49 N., R. 33 W., Kansas City, Jackson County, Missouri. Coll., F. H. Gunnell. Same as Gunnell's locality 3 and 1367 U. M.

0148 E. Quivira shale northwest of U-Smile camp on Blue Ridge cut-off and the Rock Island Railroad, Sec. 29, T. 49 N., R. 32 W., Jackson County, Missouri. Coll., S. Ellison. Same as 1375 U. M.

0144 E. Quivira shale at 75th street and Kansas City Southern Railroad, Sec. 12, T. 48 N., R. 33 W., Jackson County, Missouri. Coll., S. Ellison.

0085 E. Quivira shale 1.5 miles east of Zarah, Sec. 13, T. 12 S., R. 23 E., Johnson County, Kansas. Coll., C. C. Branson and S. Ellison.

0103 E. Quivira shale at 83rd street and Kansas City Southern Railroad, Sec. 24, T. 48 N., R. 33 W., Jackson County, Missouri. Coll., S. Ellison. Same as 1373 U. M.

349 U. M. Top of Chanute shale (Quivira ?) 4 miles south of Cameron on U. S. highway 69, Sec. 14, T. 56 N., R. 30 W., Clinton County, Missouri. Coll., R. E. Peck.

1354 U. M. Muncie Creek shale in railroad cut west of Raytown, Sec. 5, T. 48 N., R. 32 W., Jackson County, Missouri. Coll., S. Ellison.

0130 E. Muncie Creek shale in the Main street cut south of the Kansas City Union Station, Sec. 8, T. 49 N., R. 33 W., Kansas City, Jackson County, Missouri. Coll., S. Ellison. Same as 1367 U. M.

0119 E. Muncie Creek shale at Cement City, Sec. 23, T. 50 N., R. 32 W., Jackson County, Missouri. Coll., S. Ellison.

0106 E. Muncie Creek shale 2 miles south of Osawatomie on U. S. highway 169, Sec. 23, T. 18 S., R. 22 E., Miami County, Kansas. Coll., S. Ellison and W. C. Warner.

0153 E. Basal Argentine limestone 1 mile east of Morris, Sec. 27, T. 11 S., R. 24 E., Wyandotte County, Kansas. Coll., S. Ellison.

1367 U. M. Quindaro shale. Same locality as 0130 E. above. Coll., S. Ellison.

1284 U. M. Top of the Lane shale at Duntile's quarry, Sec. 17, T. 49 N., R. 33 W., Kansas City, Jackson County, Missouri. Coll., F. H. Gunnell. Same as Gunnell's locality 6.

1274 U. M. Basal Argentine limestone in the Main street cut south of the Kansas City Union Station, Sec. 8, T. 49 N., R. 33 W., Kansas City, Jackson County, Missouri. Coll., F. H. Gunnell. Same as Gunnell's locality 3.

0132 E. Quindaro shale. Same as 1367 U. M. above. Collected one year later.

1368 U. M. Shale partings in the Plattsburg limestone at 30th street and Main street, Kansas City, Sec. 16, T. 49 N., R. 33 W., Jackson County, Missouri. Coll., S. Ellison.

0128 E. Same as above but collected two blocks west.

1149 U. M. Shale parting in the Stanton limestone 5 miles south of Garnett on U. S.

highway 169, Sec. 12, T. 21 S., R. 19 E., Anderson County, Kansas. Coll., John Roberts and M. G. Mehl.

0001 E. Eudora shale 1 mile north of Parkville on Missouri highway 45, Sec. 23, T. 51 N., R. 34 W., Platte County, Missouri. Coll., S. Ellison.

0039 E. Eudora shale 1.5 miles east of Bonner Springs on road to Boy Scout camp, Sec. 27, T. 11 S., R. 23 E., Wyandotte County, Kansas. Coll., S. Ellison.

0084 E. Eudora shale 0.5 mile west of eastern boundary of Douglas County on Kansas highway 10, Sec. 10, T. 13 S., R. 21 E., Douglas County, Kansas. Coll., C. C. Branson and S. Ellison.

0002 E. Top of Weston shale 3.5 miles west of Platte City on Missouri highway 96, Sec. 29, T. 53 N., R. 35 W., Platte County, Missouri. Coll., S. Ellison.

Virgil series.—0054 E. Above Haskell limestone (Lawrence shale) 1 mile east of Lawrence, Sec. 5, T. 13 S., R. 20 E., Douglas County, Kansas. Coll., C. C. Branson and S. Ellison.

0094 E. Heebner shale (Oread limestone) 0.25 mile west of Lawrence on U. S. highway 40, Sec. 26, T. 12 S., R. 19 E., Douglas County, Kansas. Coll., S. Ellison.

0081 E. Heebner shale (lower part). Same as above.

0097 E. Heebner shale (Oread limestone) 1.25 miles west of Sedan on Kansas highway 11, Sec. 33, T. 33 S., R. 11 E., Chautauqua County, Kansas. Coll., C. C. Branson and S. Ellison.

0006 E. Queen Hill shale (Lecompton limestone) 1 mile west of Kanwaka, Sec. 34, T. 12 S., R. 18 E., Douglas County, Kansas. Coll., C. C. Branson and S. Ellison.

0007 E. Same as above.

0112 E. Larsh-Mission Creek shale (Deer Creek limestone) 6 miles west of Sedan on U. S. highway 166, Sec. 1, T. 34 S., R. 10 E., Chautauqua County, Kansas. Coll., C. C. Branson and S. Ellison.

0043 E. Larsh-Mission Creek shale (Deer Creek limestone) 2 miles west of Lecompton, Sec. 32, T. 11 S., R. 18 E., Douglas County, Kansas. Coll., C. C. Branson and S. Ellison.

0044 E. Same as above.

0095 E. Holt shale (Topeka limestone) 1.25 miles west of Wauneta on U. S. highway 166, Sec. 9, T. 34 S., R. 9 E., Chautauqua County, Kansas. Coll., C. C. Branson and S. Ellison.

0096 E. Same as above.

0011 E. Holt shale (Topeka limestone) 3 miles north of Topeka, Sec. 16, T. 11 S., R. 16 E., Shawnee County, Kansas. Coll., S. Ellison and C. C. Branson.

0013 E. Holt shale (Topeka limestone) 5 miles north of Topeka, Sec. 5, T. 11 S., R. 16 E., Shawnee County, Kansas. Coll., C. C. Branson and S. Ellison.

0014 E. Same as above.

1168 U. M. Top of Severy shale at Gage Park in Topeka, Sec. 27, T. 11 S., R. 15 E., Shawnee County, Kansas. Coll., P. Morey.

0015 E. Top of Severy shale (Aard shale) 2 miles west of Topeka on U. S. highway 40 in clay pit, Sec. 27, T. 11 S., R. 15 E., Shawnee County, Kansas. Coll., C. C. Branson and S. Ellison.

0067 E. Shale break in the Burlingame limestone 7 miles west of Topeka on Kansas highway 10, Sec. 36, T. 11 S., R. 14 E., Shawnee County, Kansas. Coll., C. C. Branson and S. Ellison.

0062 E. Shale parting in the Burlingame limestone 10 miles west of Topeka on Kansas highway 10, Sec. 34, T. 11 S., R. 14 E., Shawnee County, Kansas. Coll., C. C. Branson and S. Ellison.

0092 E. Basal Auburn (?) shale 1.5 miles west of Cedervale on U. S. highway 166, Sec. 10, T. 34 S., R. 8 E., Chautauqua County, Kansas. Coll., C. C. Branson and S. Ellison.

0066 E. Top of the Willard shale 3 miles northeast of Dover 0.5 mile south of Kansas highway 4, Sec. 20, T. 12 S., R. 14 E., Shawnee County, Kansas. Coll., C. C. Branson and S. Ellison.

Big Blue series.—1284 U. M. Shale partings in the Americus (?) limestone 3 miles west of Belvue on U. S. highway 40, Sec. 6, T. 10 S., R. 11 E., Pottawatomie County, Kansas. Coll., F. H. Gunnell. Same as Gunnell's locality 7.

0028 E. Hughes Creek shale north of Manhattan on Kansas highway 13, Sec. 7, T. 10 S., R. 8 E., Riley County, Kansas. Coll., C. C. Branson and S. Ellison.

REFERENCES

BAILEY, W. F., *1935*, Micropaleontology and stratigraphy of the lower Pennsylvanian of

Central Missouri: *Jour. Paleontology*, vol. 9, pp. 483–502.

BRANSON, CARL C., *1932*, Conodonts from the Permian Phosphoria of Wyoming: *Science*, n. s., vol. 75, pp. 337–338.

BRANSON, E. B., and MEHL, M. G., *1934*, Conodont studies: *Missouri Univ. Studies*, vol. 8, pp. 1–300.

——, *1938*, The conodont genus *Icriodus* and its stratigraphic distribution: *Jour. Paleontology*, vol. 12, pp. 155–168.

——, *1938*, Conodonts from the Lower Mississippian of Missouri: *Missouri Univ. Studies*, vol. 13, no. 4, pp. 128–137.

——, *1941*, New and little known Carboniferous conodont genera: Jour. Paleontology, vol. 15, pp. 97–106.

BRANSON, E. R., *1934*, Conodonts in the Hannibal formation: *Missouri Univ. Studies*, vol. 8, pp. 301–345.

BURNLEY, GERTRUDE I., *1938*, Conodonts of the Lexington Coal zone (Pennsylvanian) of Missouri: Unpublished Master's thesis, University of Missouri.

ELLISON, SAMUEL, *1938*, Missouri series (Pennsylvanian) conodonts of Jackson County, Missouri: Unpublished Master's thesis, University of Missouri.

GIRTY, G. H., *1915*, Invertebrate Paleontology (Stratigraphy of the Pennsylvanian of Missouri): *Missouri Bur. Geol.* and *Mines*, 2nd ser., vol. 13, p. 268.

GUNNELL, F. H., *1931*, Conodonts from the Ft. Scott limestone of Missouri: *Jour. Paleontology*, vol. 5, pp. 244–255.

——, *1933*, Conodonts and fish remains from the Cherokee, Kansas City, and Wabaunsee groups of Missouri and Kansas: *Jour. Paleontology*, vol. 7, pp. 261–297.

HARLTON, N. H., *1933*, Micropaleontology of the Permian of Johns Valley shale of the Ouachita mountains: *Jour. Paleontology*, vol. 7, pp. 3–29.

HARRIS, R. W., and HOLLINGSWORTH, R. V., *1933*, New Pennsylvanian conodonts from Oklahoma: *Am. Jour. Sci.*, 5th. ser., vol. 25, pp. 193–204.

HINDS, HENRY, and GREENE, F. C., *1915*, Stratigraphy of the Pennsylvanian series of Missouri: *Missouri Bur. of Geol. and Mines*, 2nd. ser., vol. 13, pp. 1–214.

JONES, D. J., *1935*, Conodont assemblages from the Nowata shale: *Jour. Paleontology*, vol. 9, p. 364. (Paper read before the Soc. Econ. Paleontologists and Mineralogists, March 23, 1935).

——, *1939*, Conodont fauna of the Seminole of northeastern Oklahoma: *Oil and Gas Jour.*, vol. 37, no. 45, p. 74. (Abstract).

MOORE, R. C., *1929*, Environment of Pennsylvanian life in North America: *Am. Assoc. Petroleum Geologists, Bull.*, vol. 13, pp. 459–487.

——, *1931*, Pennsylvanian cycles in the northern Midcontinent region: *Illinois Geol. Surv.*, vol. 60, pp. 247–257.

——, *1932*, A reclassification of the Pennsylvanian system in the northern Midcontinent region: *Kansas Geol. Soc. Guidebook*, 6th. Annual Field Conference, pp. 90–97. (Cites Newell and Jewett, whose work was not fully published until 1936 in the *Kansas Geol. Surv.*, Bull. 21).

——, *1936*, Stratigraphic classification of the Pennsylvanian rocks of Kansas and Missouri in collaboration with H. K. Elias, F. C. Greene, and N. D. Newell: *Kansas Geol. Soc. Guidebook*, 10th. Annual Field Conference, pp. 7–73.

——, *1936*, Stratigraphic classification of the Pennsylvanian rocks of Kansas: *Kansas Geol. Surv.*, Bull. 22, pp. 1–190.

STAUFFER, C. R., and PLUMMER, H. J., *1932*, Texas Pennsylvanian conodonts and their stratigraphic relations: *Texas Univ. Bull.*, no. 3201, pp. 13–50.

ULRICH, E. O., and BASSLER, R. S., *1926*, A classification of the tooth-like fossil conodonts with descriptions of American Devonian and Mississippian species: *U. S. Nat. Mus. Proc.*, no. 2613, vol. 68, art. 12, pp. 1–63.

MANUSCRIPT RECEIVED BY THE EDITOR JANUARY 10, 1940.

JOURNAL OF PALEONTOLOGY, VOL. 15, NO. 2, PP. 144–152, PLS. 24, 25, MARCH, 1941

TEXTULARIA FROM THE TEXAS TERTIARY[1]

FLAVY E. DAVIS
Gulf Oil Corporation, Houston, Texas

ABSTRACT—Twenty-two species and varieties of *Textularia* from the Tertiary of Texas are described and figured. Of these, six species and two varieties are new. Their distribution is discussed.

BECAUSE no special study has been published of the species of *Textularia* in the Tertiary of Texas, the writer has made an investigation of the species and varieties of this genus.

There are numerous *Textularia* species in the Tertiary, some of which are excellent guides. Knowing that more work will be done on this subject, it is apparent that the known ranges of the Textularias must be revised from time to time. However, a chart compiled from the available information is presented, and it is hoped that the data included in this paper will help those who later will do additional work on the problem.

Some of the names given to species of *Textularia* by early authors are being used in Texas at the present time; a number of them erroneously. Specimens which do not fit previous descriptions should be segregated and described as new species. In view of the inadequacy of some of the early descriptions and illustrations of Foraminifera it is highly important to obtain authentic specimens for purposes of comparison with unidentified material. Naturally such authentic specimens are not in every case available, and in such instances recognition must be somewhat uncertain.

Authorities are not in full agreement regarding the latitude that should be ascribed to the genus *Textularia*. Some authors state that the genus should include only those species that are biserial throughout. Their conclusions are based on Defrance's original description and do not take into consideration the fact that this description was inadequate. According to Cushman, thin sections of *Textularia sagittula* from the type locality studied by Lacroix reveal that the species is coiled in both microspheric and megalospheric forms. Many of the species of *Textularia* examined in the course of the present study are coiled. Probably coiling will be found in the early stages of all Textularias.

[1] Published with the permission of the Gulf Oil Corporation.

DISTRIBUTION

The subsurface geology of the Gulf Coast Tertiary differs materially from the outcrops. Beds at the surface do not illustrate the complete subsurface section in lithology, mode of deposition, thickness, or fossil content. The subsurface beds are marginal deposits formed along the constantly oscillating shore line of the Gulf of Mexico. Offshore deposits, such as the *Discorbis*, *Heterostegina*, and *Marginulina* zones are not represented at the surface. Thus, because certain beds with their distinctive fossils do not outcrop at the surface, it is often necessary to use well samples in describing new species.

The sediments of the Tertiary period are products of lacustrine, fluviatile, eolian, brackish water, and marine origin. Occasionally the ocean extended inland over the Gulf Coast area to produce marine deposits.

The Tertiary period was characterized by a continuously oscillating strand line. Only during major inundations were thick shale beds deposited. During the remainder of time sand, sandy shale, clay, bentonite, and volcanic ash were laid down.

The predominance of arenaceous sediments appears to harmonize with species of *Textularia* in the Gulf Coast Tertiary.

COLLECTIONS

Much of the material for this paper was collected by the writer from surface outcrops. Well cores and cuttings were generously donated by several oil companies. Several samples were obtained from the University of Texas collection, and others came from private collections, including

TABLE 1.—CLASSIFICATION OF STRATIGRAPHIC DIVISIONS IN TEXAS[1]

Age	Group		Formation	Member Northeast Texas	Member Southwest Texas
Pleistocene	Houston		Beaumont	Undivided	Undivided
			Lissie	Undivided	Undivided
Pliocene	Citronelle		Goliad	Undivided	Labahia Lagarto Creek beds Lapara
Pliocene and Miocene	Fleming		Lagarto	Undivided	Undivided
			Oakville	Undivided	Undivided
Oligocene?	Gueydan		Catahoula	Onalaska Chita	Chusa Soledad Fant
Oligocene			Subsurface strata	Discorbis zone Heterostegina zone Marginulina zone	Discorbis zone Heterostegina zone Marginulina zone
			Frio	Absent east of Brazos	Undivided
			Subsurface strata	Undivided	Undivided
Eocene	Jackson		Fayette	Whitsett McElroy Caddell	Whitsett Lipan
	Claiborne		Yegua	Undivided	Undivided
		Cook Mt.*	Crockett	Undivided	Undifferentiated south of Atascosa County
			Sparta	Undivided	
		Mt. Selman*	Weches	Undivided	Undifferentiated south of Atascosa County
			Queen City	Undivided	
			Reklaw	Undivided	
			Carrizo	Undivided	Undivided
	Wilcox		Sabinetown	Undivided	Undivided
			Rockdale	Calvert Bluff Simsboro Butler	Undivided
			Seguin	Caldwell Knob Solomon Creek	Caldwell Knob Solomon Creek
	Midway		Wills Point	Kerens Wortham Mexia	Absent for most part
			Kincaid	Pisgah Littig	Pisgah Littig

[1] Texas Univ. Bull. 3232, p. 530.
* According to United States Geological Survey usage in 1932.

TABLE 2.—RANGE OF TEXTULARIAS IN TEXAS TERTIARY

Species	Beaumont	Lissie	Goliad	Lagarto	Oakville	Catahoula	Discorbis	Heterostegina	Marginulina	Frio	Vicksburg	Whitsett	McElroy	Caddell	Yegua	Crockett	Sparta	Weches	Queen City	Reklaw	Carrizo	Sabinetown	Rockdale	Seguin	Wills Point	Kincaid
adalta												P														
claibornensis															P	P										
cuyleri														P												
dibollensis														A												
dibollensis var. *humblei*														P												
gertrudeana												VR	R	R	R											
hannai															P											
hockleyensis												VR	A													
isabelensis					X																					
israelskyi					X																					
mississippiensis											P															
mississippiensis var. *alabamensis*											P															
mississippiensis var. *crockettensis*																P										
mississippiensis var. *elongata*												P														
mississippiensis var. *rhomboidea*														P												
plummerae																									VR	
recta								P																		
smithvillensis																		A								
stapperi					X																					
subhauerii								P	P																	
tumidula											P															
warreni											A															

VA=Very abundant, A=Abundant, P=Present, R=Rare, VR=Very rare, X=Occurrence in undifferentiated beds of Miocene age.

those of W. G. Parker and Donald W. Gravell.

Hundreds of samples were examined and from them the following list of best collecting localities was compiled.

Outcrop localities:

1. Whitsett, at type locality of Olmos sandstone in Olmos Creek, Live Oak County.
2. Whitsett, on east side of road on hill on west edge of town of Whitsett, Live Oak County.
3. Yegua, in road cut 1.8 miles from West Point, north of Smithville, Bastrop County.
4. Crockett, from under bridge that crosses the Brazos River between Bryan and Caldwell, Brazos County.
5. Lower Crockett, on road between Caldwell and Bryan, ½ mile above Little Brazos River bridge, Brazos County.
6. Weches, outcrop about 1000 feet upstream from bridge on Colorado River at Smithville, Bastrop County.
7. Wills Point, outcrop in Bem Brick Pit (Alamo Brick Company) San Antonio, Bexar County. Bottom of pit.
8. Caddell, in Stovall Creek, 3½ miles east of Diboll, Angelina County.

Well location of subsurface samples:

Gulf Production Company's Keeran no. 14, Martin de Leon Survey, Victoria County. Depth 7850–53 core.

Continental Oil Company's Weakly no. 1, Joseph Clements Survey, Wharton County. Depth Heterostegina Zone.

Magnolia Petroleum Company's Beck no. 1, T. & N. O. R. R. Survey, no. 1, Abst. 407, Victoria County. Depth 4525 (core) Vicksburg.

Stapper Petroleum Company, no. 1, 15 miles northwest of Port Isabel, Cameron County. Potrero Del Esperitu Santo Grant. Miocene.

United Production Company's Ray no. 34, Bee County. Thomas Hanson Survey, Abst. A-172. Depth 3921–27 (core) Caddell.

United Production Company's Ray no. 34, Bee County. Thomas Hanson Survey, Abst. A-172. Depth 3775–95 (core) McElroy.

United Production Company's Ray no. 34, Bee County. Thomas Hanson Survey, Abst. A-172. Depth 2943–44 (core) Whitsett.

United Production Company's Ray no. 44, Bee County. S. Morris Survey, Abst. A-592. Depth 3254–3515 (cuttings) McElroy.

United Production Company's Ray no. 36, Bee County. Thomas Hanson Survey, Abst. A-172. Depth 3795–3901 (cores and cuttings) McElroy.

United Production Company's Ray no. 49, Bee County, W. J. Porter Survey, Abst. 529. Depth 3390–3500 (cores and cuttings) McElroy.

United Production Company's Ray no. 32, Bee County. Depth 3670–3927 (cores and cuttings) Caddell.

Humble Oil & Refining Company, Duncan State Land no. 1. Depth 2974–86 (core) Vicksburg.

Humble Oil and Refining Company, Hammerstrom no. 7. Fort Bend County, Samuel Kennedy Survey, Abst. 44. Depth 3226–40 (core) Discorbis.

Strake-Delaware Inc. Moody no. 1. Chas. B. Stewart Survey, Abst. 476. Montgomery County. Depth 3885–5200 (cores)

Gulf Oil Corp. no. 58 Moore, Orchard Field, Fort Bend County, Texas. Depth 7653–58 (core) Yegua.

SYSTEMATIC DESCRIPTION

Family TEXTULARIIDAE

Genus TEXTULARIA Defrance, 1824

Texularia DEFRANCE, *1824*, Dist. Sci. Nat., vol. 32, p. 107.

Testilaria EHRENBERG and later authors, *1824*, plecanium Reuss.

Test free, elongate, tapering, typically compressed with the zigzag line between the chambers on the middle of the flattened side, early chambers in the microspheric form usually planispirally coiled, later biserial chambers simple, not labyrinthic; wall arenaceous, cement of various sorts, the relative amounts variable; aperture, typically an arched slit at the inner margin of the chamber, occasionally in the apertural face. Cambrian to Recent.

The structure of the early Paleozoic forms is not thoroughly known and needs study of thin sections by modern petrographic methods. Lacroix has recently shown that the type species, *T. sagittula* Defrance, has a coiled stage in both the microspheric and megalospheric forms, but that they are short compared to *Spiroplectammina biformis* and related species.

TEXTULARIA ADALTA Cushman

Plate 24, figures 1, 2a, 2b

Textularia adalta CUSHMAN, *1926*, Cushman Lab. Foram. Research Contr., vol. 2, p. 29, pl. 4, figs. 2a, b. ELLISOR, *1933*, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 6, fig. 2. PLUMMER, *1932*, Texas Univ. Bull. 3232, p. 696. CUSHMAN, *1935*, U. S. Geol. Survey Prof. Paper 181, p. 7, pl. 1, figs. 11, 12.

Test elongate, slender early portion tapering and compressed, later portion rounded with sides nearly parallel; chambers are small and depressed, later ones are large and rounded; sutures fairly distinct, more so in later portion, depressed; walls finely arenaceous with large grains scattered to give the test a rough appearance; periphery uneven and rounded; aperture a high opening at base of last chamber. Length, 1.1–1.4 mm.

Occurrence.—This species is present in the Whitsett and probably ranges into the McElroy.

Figured specimen from United Production Company's Ray no. 34, Bee County, depth 2943–44 Whitsett.

TEXTULARIA CLAIBORNENSIS

Weinzierl and Applin

Plate 24, figures 5a, 5b, 6

Textularia claibornensis, WEINZIERL and APPLIN, *1839*, Jour. Paleontology, vol. 3, no. 4, p. 392, pl. 44, figs. 1a, b. PLUMMER, *1933*, Texas Univ. Bull. 3232, p. 665 (list).

Test elongate, rounded and very slightly compressed; chambers numerous, early portion low, remainder portion high and distinct, inflated and twice the height of early chambers; sutures indistinct in early stage and distinct in rest of test, depressed in last few divisions; walls smooth, finely arenaceous; periphery subacute; aperture a broad angular opening at base of last formed chamber. Length 1.0–1.3 mm.

Occurrence.—This species is very common in the more sandy phases of the Yegua and is present in the Crockett.

Figured specimen from Crockett outcrop in Pinoak Creek, Bastrop County.

TEXTULARIA CUYLERI Davis, n. sp.

Plate 24, figures 3a, 3b, 4

Test short, increasing in size from a pointed apex to a broad apertural end; chambers low, increasing in size with each newly added chamber; walls coarsely arenaceous but showing a fine base when worn down; aperture a broad arch at base of inner margin of last formed chamber; periphery sub-acute. Length 0.53 mm.

Characterized by its small size, perfect

symmetry and broad, flat apertural end.

Occurrence.—This species was found only in the Whitsett. There is a similar species in the Yegua but it has a round periphery.

Remarks.—Named in honor of Dr. Robert H. Cuyler.

Type specimen from United Production Company's Ray no. 34, Bee County, depth 2941–44. Core Whitsett.

TEXTULARIA DIBOLLENSIS
Cushman and Applin
Plate 24, figures 7a, 7b

Textularia dibollensis CUSHMAN and APPLIN, *1926*, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 165, pl. 5, figs. 12–19; ——, *1928*, Jour. Paleontology, vol. 1, p. 148, pl. 23, fig. 1. ELLISOR, *1938*, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, p. 1301, pl. 1, fig. 4. PLUMMER, *1935*, Texas Univ. Bull., 3232, p. 665 (list). CUSHMAN, *1935*, U. S. Geol. Survey Prof. Paper 181, p. 8, pl. 1, figs. 13–16.

Test small, short and broad, first few chambers of initial end very small and forming a pointed end, then rapidly expanding to largest portion of test, smaller toward apertural end, chambers rounded and becoming high, initial chamber highest; sutures indistinct, not depressed, at right angles to the periphery; wall finely arenaceous; aperture a broad arched opening at base of last formed chamber. Length 0.55–0.70 mm.

Occurrence.—Found only in Caddell. Originally described from the upper Eocene outcropping 4 miles east of Diboll, Angelina County, Texas.

Figured specimen from Stovall Creek 3½ miles east of Diboll, Angelina County, Texas.

TEXTULARIA DIBOLLENSIS
Cushman and Applin
var. HUMBLEI Cushman and Applin
Plate 24, figures 9a, 9b

Textularia dibollensis var. *humblei* CUSHMAN and APPLIN, *1924*, Am. Assoc. Petroleum Geologists Bull., vol. 8, p. 443; ——, *1926*, idem., vol. 10, p. 105, pl. 6, fig. 9. ELLISOR, *1933*, idem., vol. 17, no. 11, p. 1301. PLUMMER, *1932*, Texas Univ. Bull., 3232, p. 695 (list). CUSHMAN, *1935*, U. S. Geol. Survey Prof. Paper 181, p. 8, pl. 1, figs. 17a, b.

Variety differs from the typical in that it is larger, more elongate, more symmetrical, the greatest width being at apertural end; the sutures are more distinct and depressed, and the periphery somewhat more acute; the initial end is not as pointed. Length 1.00 mm.

Occurrence.—Only in Caddell.

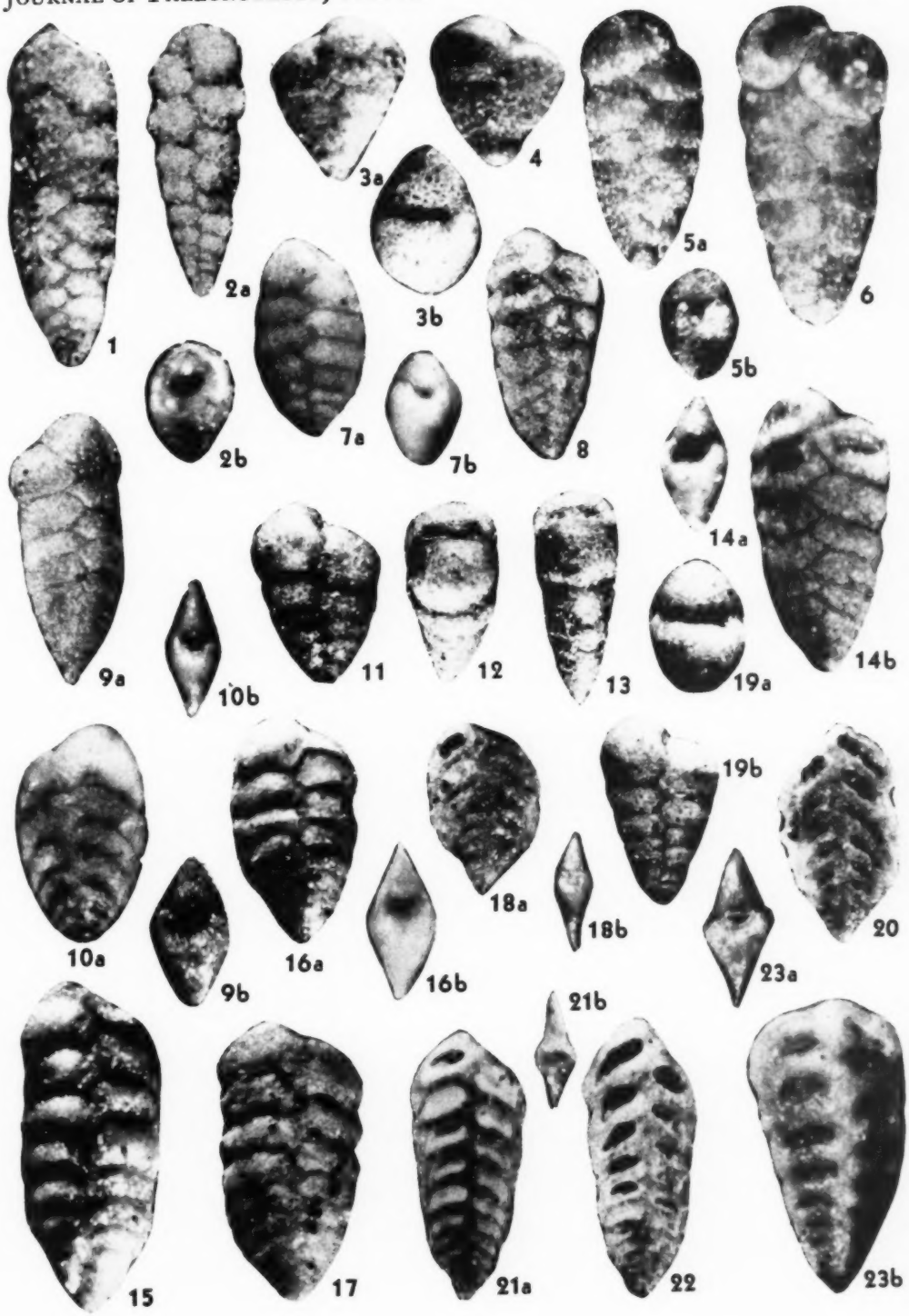
Figured specimen from United Production Company's Ray no. 32, Bee County, Texas, depth 3670–90 feet.

TEXTULARIA GERTRUDEANA
Davis, n. sp.
Plate 24, figures 8, 14a, 14b

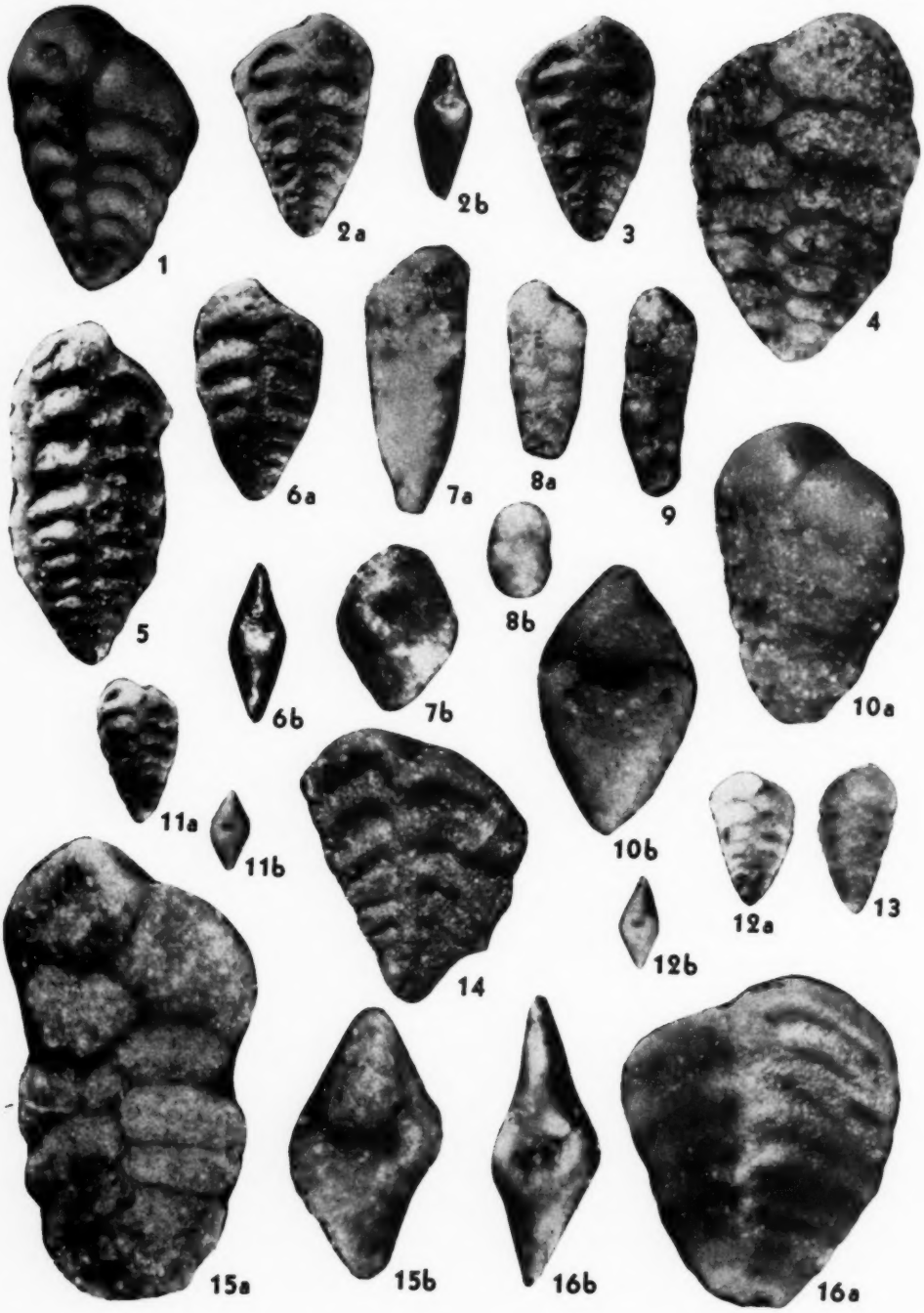
Test elongate, rather slim, not much depressed; chambers small, even, not inflated; sutures not very distinct in early stage, distinct in old age, even with chambers; walls finely arenaceous, thin, perforate; periphery regular, sub-acute; aperture in a high, narrow arch on inner margin of last formed chamber. Length 0.85–1.1 mm.

EXPLANATION OF PLATE 24

FIGS. *1, 2a, 2b—Textularia adalta* Cushman, ×37; *2b*, apertural view of *2a*. (p. 147)
3a, 3b, 4—Textularia cuyleri Davis, n. sp., ×37; *3b*, apertural view of *3a*. Syntype. (p. 147)
5a, 5b, 6—Textularia claibornensis Weinzierl and Applin, ×37; *5b*, apertural view of *5a*. (p. 147)
7a, 7b—Textularia dibollensis Cushman and Applin, ×37; *7b*, apertural view of *7a*. (p. 148)
8, 14a, 14b—Textularia gertrudeana Davis, n. sp., ×37; *14a* is apertural view of *14b*. *14b* is holotype. (p. 148)
9a, 9b—Textularia dibollensis var. *humblei* Cushman and Applin, ×37. (p. 148)
10a, 10b—Textularia isabelensis Davis, n. sp., ×50; *10b*, apertural view. Holotype. (p. 149)
11–13, 19a, 19b—Textularia hannai Davis, n. sp., ×26; *19a*, apertural view of *19b*. *19b* is holotype. (p. 149)
15–17—Textularia mississippiensis Cushman, ×37; *16b*, apertural view of *16a*. (Byram Marl) (p. 150)
18a, 18b, 20—Textularia mississippiensis var. *rhomboidea* Cushman and Ellisor ×37; *18b*, apertural view of *18a*. (p. 151)
21a, 21b, 22—Textularia mississippiensis var. *elongata* Davis, n. sp., ×37; *21b*, apertural view of *21a*. *21a* is holotype. (p. 151)
23a, 23b—Textularia israelskyi Davis, n. sp., ×50; *23b*, apertural view. Holotype. (p. 150)



Davis, Tertiary Textularias



Davis, Tertiary Textularias

Characteristics.—Long, well formed, broadest in middle, narrow and slightly rounded periphery.

Occurrence.—This species ranges from Whitsett through the Yegua.

Figured specimen from Yegua outcrop in road cut 1.8 miles north of West point on Smithville road, Bastrop County, Texas.

TEXTULARIA HANNAI Davis, n. sp.
Plate 24, figures 11–13, 19a, 19b

Test fairly short, apex pointed, end view oval-shaped, not depressed; chambers numerous, steadily increasing in size; sutures indistinct in early stages, depressed and very distinct in last few divisions; wall arenaceous; periphery rounded; aperture a long opening at base of last formed chamber. Length 1.0 mm.

Characteristics.—This species is easily distinguished from other species of *Textularia* by its very stout and fairly short test.

Occurrence.—Between the *Camerina* zone and *Discorbis yeguaensis*. Approximately 20 feet below *Camerina* zone. This species was found to be a very good marker.

Type specimen from Gulf Oil Corp. Kirby C-7. Depth 5645–50. Core.

TEXTULARIA HOCKLEYENSIS
Cushman and Applin
Plate 25, figure 1

Textularia hockleyensis CUSHMAN and APPLIN, *1926*, Am. Assoc. Petroleum Geologists Bull., vol. 19, p. 164, pl. 6, figs. 3–6. DUMBLE, *1924*, idem., vol. 8, p. 443 (nomen nudum). ELLISOR, *1933*, idem., vol. 17, no. 11; HOWE and WALLACE, *1932*, Louisiana Geol. Bull. no. 2, pp. 11–13. PLUMMER, *1932*, Texas Univ. Bull., 3232, p. 696 (list).

Test large, compressed, the central portion thickest, thence with a depressed area between middle and periphery; chambers numerous, distinct, becoming large in early stage; sutures distinct, curved downward; walls arenaceous but smoothly finished; periphery thin and rounded, fairly even; aperture a low curved opening at base of last chamber. Length 1.0 mm.

T. hockleyensis is not diagnostic of the top of the McElroy (80 feet to 100 feet) in Bee County. This species is almost exclusively confined to the McElroy in East Texas where the specimens usually are deformed. *T. hockleyensis* ranges into the Whitsett in West Texas.

Type locality.—Wooley's Bluff clays in San Augustine County, Texas. Another good exposure is on the Long Bell Lumber Company's 5000 acre tract, Stephen Stanley survey, Angelina County, Texas.

Figured specimen from United Production Company's Ray no. 34, Bee County, Texas. Depth 3775–95. MeElroy.

TEXTULARIA ISABELENSIS
Davis, n. sp.
Plate 24, figures 10a, 10b

Test small, outline uniformly curved, heart shaped; chambers few, small, not distinct; sutures slightly depressed, concave; walls arenaceous with much cement giving a glassy covering; periphery sharp; aperture in a depression on inner margin of last formed chamber, apertural end rounded. Length 0.70 mm.

Characteristics.—Rhomboid outline.

Occurrence.—Found in the Miocene.

Type specimen from Stapper Petroleum Company's no. 1 Espiritu Santo grant 15

EXPLANATION OF PLATE 25

FIGS. *1*—*Textularia hockleyensis* Cushman and Applin, ×40. (p. 149)
2a, 2b, 3—*Textularia mississippiensis* var. *alabamensis* Cushman, ×37; *2b*, apertural view of *2a*. (p. 150)
4—*Textularia smithvillensis* Cushman and Ellisor, ×50. (p. 151)
5, 6a, 6b—*Textularia mississippiensis* Cushman, ×37; *6b*, apertural view of *5a*. (Vicksburg of Texas) (p. 150)
7a, 7b—*Textularia recta* Cushman, ×50; *7b*, apertural view. (p. 151)
8a, 8b, 9—*Textularia plummerae* Lalicker, ×50; *8b*, apertural view of *8a*. (p. 151)
10a, 10b—*Textularia tumidula* Cushman, ×40; *10b*, apertural view. (p. 152)
11–13—*Textularia mississippiensis* var. *crockettensis* Cavis, n. sp., ×37; *12b*, apertural view of *12a*. *11a* is holotype. (p. 150)
14—*Textularia warreni* Cushman and Ellisor, ×40. (p. 152)
15a, 15b—*Textularia subhauerii* Cushman, ×37; *15b*, apertural view. (p. 152)
16a, 16b—*Textularia stapperi* Cavis, n. sp., ×50; *16b*, apertural view. Holotype. (p. 152)

miles northwest of Port Isable, Cameron County, Texas. Depth 3805–35.

TEXTULARIA ISRAELSKYI
Davis, n. sp.
Plate 24, figures 23a, 23b

Test very elongate; median suture between two lateral series of chambers elevated to produce lateral angulation as seen from apertual view; greatest thickness of test along the crest of this ridge on either side; chambers steadily increasing in size, never very high, slightly depressed; sutures distinct, concave; walls finely arenaceous with much cement, a glassy surface when not worn; periphery sharp, even; aperture a small arch in a broad depression at base of last formed chamber. Length 0.85 mm.

Characteristics.—Elongate, angular.

Occurrence.—Found in Miocene.

Remarks.—Named in honor of M. C. Israelsky.

Type specimen from Stapper Petroleum Company's no. 1, Espiritu Santo grant 15 miles northwest of Port Isabel, Cameron County, Texas. Depth 2790–2810.

TEXTULARIA MISSISSIPPIENSIS
Cushman
Plate 24, figures 15, 16a, 16b, 17
Plate 25, figures 5, 6a, 6b

Textularia mississippiensis CUSHMAN, *1922*, U. S. Geol. Survey Prof. Paper 129, pp. 90, 125, pl. 14, fig. 4; ——, *1923*, idem., Prof. paper 133, p. 17. CUSHMAN and APPLIN, *1926*, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 166, pl. 6, figs. 10, 11. CUSHMAN and THOMAS, *1929*, Jour. Paleontology, vol. 3, p. 177, pl. 23, figs. 1a, b. CUSHMAN,, *1929*, Cushman Lab. Foram. Research Contr., vol. 5, p. 79, pl. 12, fig. 5. HOWE and WALLACE, *1932*, Louisiana Dept. Cons. Geol. Bull. 2, p. 19, pl. 1, figs. 7a, b.

Test elongate, fairly broad, thickest in middle, thence thinning toward periphery, sides becoming somewhat parallel in later stages; chambers low, gradually increasing in size; sutures depressed and covered by a coarsely arenaceous layer, angular meeting at center, curved downward; periphery sharp but having no keel, irregular; walls finely arenaceous; aperture a low arch at base of last formed chamber. Length 0.75–1.1 mm.

Remarks.—Three specimens are figured, from the Byram marl under the wagon bridge over Pearl River, Byram, Mississippi. Two specimens are figured from Vicksburg of Texas (Gulf Keeran no. 14, Victoria County, Texas Depth 7850–53 core).

Plate 24, figures 15–17 are from Byram. Plate 25, figures 5, 6a, 6b are from Vicksburg.

TEXTULARIA MISSISSIPPIENSIS var.
ALABAMENSIS Cushman
Plate 25, figures 2a, 2b, 3

Textularia mississippiensis var. *alabamensis* CUSHMAN, *1923*, U. S. Geol. Survey Prof. Paper 133, p. 17, pl. 1, fig. 4; ——, *1935*, idem., Prof. Paper 181, p. 7, pl. 1, figs. 3–6. ELLISOR, *1933*, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 1, fig. 6.

Test elongate, thick, thinning toward periphery, in end view biconvex; chambers low and broad, not depressed, small in early stage and becoming larger gradually with age; sutures distinct, excavated, curved downward, meeting at center in distinct angular contact with sutures at opposite chamber not forming a ridge; walls smoothly arenaceous; periphery even, thin. Length 0.73 mm.

Occurrence.—This species was found in Vicksburg (lower Oligocene).

Figured specimen from Gulf Production Company's Keeran no. 14, Victoria County, Texas.

TEXTULARIA MISSISSIPPIENSIS var.
CROCKETTENSIS Davis n. var.
Plate 25, figures 11–13

Test small, rather angular, not depressed, thickest in middle with sharp periphery; chambers small, low; sutures distinct, slightly depressed, curved downward; walls very finely arenaceous, smooth; periphery sharp; aperture a small almost round opening at base of last formed chamber. Length 0.40 mm.

The variety *crockettensis* differs from the typical species in not having parallel sides, and in being smaller and cuneate.

Occurrence.—Found only in Crockett.

Type specimen from Crockett outcrop under bridge over Brazos River between Bryan and Caldwell, on county line of Brazos and Burleson Counties.

TEXTULARIA MISSISSIPPIENSIS var. ELONGATA Davis, n. var.
Plate 24, figures 21a, 21b, 22

Test very elongate, gradually tapering; chambers numerous, low, slightly depressed; sutures raised, covered with finely arenaceous material, curved downward with pronounced curving close to periphery; periphery slightly serrate and thin; aperture an oval-shaped opening at base of last formed chamber. Length 0.95 mm.

Differs from *T. mississippiensis* in having a sharp periphery and in being slimmer and longer.

Occurrence.—Ovigerina zone in Whitsett.

Type specimen from Strake-Delaware no. 1 Moody in Montgomery County, Texas. Depth 4203–12. Core.

TEXTULARIA MISSISSIPPIENSIS var. RHOMBOIDEA Cushman and Ellisor
Plate 24, figures 18a, 18b, 20

Textularia mississippiensis var. *rhomboidea* CUSHMAN and ELLISOR, *1931*, Cushman Lab. Foram. Research Contr., vol. 7, part 3, p. 52, pl. 7, figs. 2a, b; ——, *1933*, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11.

Test elongate, thin, in end view biconvex; chambers low and broad, depressed, curved downward; sutures distinct, excavated; walls smoothly arenaceous; periphery even and thin. Length 0.54–0.75 mm.

This species is easily distinguished from *T. alabamensis* in its rhomboid outline and much compressed test.

Occurrence.—Found in upper Eocene, mostly in Caddell.

Type specimen from United Production Company's Ray no. 32, Bee County, Texas. Depth 3670–90.

TEXTULARIA PLUMMERAE Lalicker
Plate 25, figures 8a, 8b, 9

Textularia eocaena PLUMMER, *1926*, Texas Univ. Bull. 2644, p. 67, pl. 3, figs. 2a, b.
Textularia plummerae LALICKER, *1935*, Cushman Lab. Foram. Research Contr., vol. 11, part 2.

Test very elongate, tapering, slightly compressed; chambers high, last few somewhat inflated, moderately rough, the final one being smoother; sutures indistinct in early portion of test, somewhat depressed above; walls coarsely arenaceous; periphery rounded; aperture an arched slit at base of last formed chamber in a shallow depression in the septal face. Length 0.70–0.80 mm.

This species is distinctly more elongate than *T. agglutinans*. It is rare, and frequently composed of white sand grains.

Occurrence.—This species is not limited to the Midway but occurs very commonly in Tertiary formations.

Figured specimen from Bem Brick Pit (Alamo Brick Company) San Antonio, Texas. Bottom of pit.

TEXTULARIA RECTA Cushman
Plate 25, figures 7a, 7b

Textularia recta CUSHMAN, *1923*, U. S. Geol. Survey Prof. Paper 133, p. 17, pl. 1, fig. 2; ——, *1935*, U. S. Geol. Survey Prof. Paper 181, p. 7, pl. 1, figs. 8, 9.

Test very long, slightly compressed in middle, early portion rapidly increasing in size, later portion with equal sized chambers and sides parallel; chambers numerous, high and not very broad; sutures distinct, forming a symmetrical angle with sutures of opposite chamber then forming a straight line perpendicular to periphery; wall thick, covered with agglutinated calcareous material, perforated; periphery regular; aperture an arched depression at base of last formed chamber. Length 0.90 mm.

Occurrence.—This specimen was found only in *Heterostegina* zone.

Figured specimen from Continental Oil Company's Weakley no. 1, Joseph Clements, Survey, Wharton County.

TEXTULARIA SMITHVILLENSIS Cushman and Ellisor
Plate 25, figure 4

Textularia smithvillensis, CUSHMAN and ELLISOR, *1934*, Cushman Lab. Foram. Research Contr., vol. 9, part 4, p. 95, pl. 10, figs. 10a, b.

Test moderately long, very angular, not depressed, thickest in middle with an acute periphery; chambers low, gradually increasing in size, last two forming a sub-acute angle; sutures not very distinct, slightly depressed, with walls coarsely arenaceous but quite smoothly finished; periphery acute, thin and very regular; aperture a low arched opening at base of last formed chamber. Length 1.1–1.5 mm.

This species seems to be the ancestor of the related species *T. hockleyensis*.

Occurrence.—Found only in the Weches formation.

Figured specimen from type locality *T. smithvillensis*, Weches formation, south bank of Colorado River at Smithville, Bastrop County, Texas.

TEXTULARIA STAPPERI Davis n. sp.
Plate 25, figures 16a, 16b

Test large, stout with angular features, the middle is very thick, the test being slightly concave from middle to periphery; chambers low, broad, from eight to nine in number, not distinct; sutures a thin depressed line, not distinct, arched downward; walls finely arenaceous, with a glassy covering; periphery angular but not sharp, fairly even; aperture a rounded arch in a depression at base of last formed chamber. Length 0.85–1.2 mm.

Characteristics.—Stout, glassy covering, angular features.

Occurrence.—Miocene.

Type specimen from Stapper Petroleum Company's well no. 1, Espiritu Santa grant, 15 miles northwest of Port Isabel, Cameron County, Texas. Depth 2940–80.

TEXTULARIA SUBHAUERII Cushman
Plate 25, figures 15a, 15b

Textularia subhauerii CUSHMAN, *1921*, U. S. Geol. Survey Prof. Paper 129, pp. 89, 126, pl. 14, figs. 2a, b; ——, *1923*, idem., Prof. Paper 133, p. 16; ——, *1935*, idem., Prof. Paper 181, p. 7, pl. 1, fig. 10.

Test large, stout, elongate, early portion rapidly increasing in width with each newly added chamber, later adult portion with sides nearly parallel; chambers numerous; sutures usually rather indistinct; wall coarsely arenaceous, but smoothly finished; periphery rounded, but central portion of test is flat; aperture at base of inner margin of last formed chamber. Length 1.5–2.0 mm.

Occurrence.—The range of this species is rather indefinite. It was found in *Discorbis* and *Heterostegina* zones and again in the Yegua.

Figured specimen from *Heterostegina* zone in Continental well in Wharton County, Texas. (Continental's Weakley n. 1).

TEXTULARIA TUMIDULA Cushman
Plate 25, figures 10a, 10b

Taxtularia tumidula, CUSHMAN, *1921*, U. S. Geol. Survey Prof. Paper 129, p. 89, pl. 15, figs. 1, 2a, b. ELLISOR, *1933*, Am. Assoc. Petroleum Geologists Bull., vol. 17, pl. 1, fig. 3, pp. 1321–1322. PLUMMER, *1933*, Texas Univ. Bull. 3232, p. 702 (list).

Test large, elongate, compressed, thickest in central region, thence thinning toward the periphery, initial end rapidly broadening in the adult, then thinning again; wide at apertural end; chambers numerous, not symmetrical, very high in adult, last formed chamber being much larger than others; sutures not very distinct; wall arenaceous but smoothly finished. Length 1.2–1.5 mm.

Characterized by its central tumid area with longitudinal channels at each side.

Occurrence.—This species was found only in Vicksburg.

Figured specimen from Magnolia Petroleum Company's Beck no. 1, Victoria County, Texas. Depth 4525.

TEXTULARIA WARRENI Cushman and Ellisor
Plate 25, figure 14

Textularia warreni CUSHMAN and ELLISOR, *1931*, Cushman Lab. Foram. Research Contr., vol. 7, part 3, p. 52, pl. 7, figs. 2a, b.
Textularia warreni, ELLISOR, *1933*, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pp. 1321–1322.

Test large, compressed, with walls of chambers greatly depressed giving a ribbed appearance; chambers low and broad, steadily increasing in size with age; sutures large, distinct, concave, meeting at middle to form a heavy straight ridge; walls finely arenaceous, with a heavy outside covering of material, the removal of which displays punctations on the inner layer; when this is removed the inside is punctate; periphery very uneven and irregular; aperture a high, narrow opening at base of last formed chamber. Length 0.90–1.0 mm.

Occurrence: Vicksburg only.

Figured specimen from Magnolia Petroleum Company's Beck no. 1, Victoria County, Texas. Depth 4525.

MANUSCRIPT RECEIVED BY THE EDITOR FEBRUARY 18, 1939.

JOURNAL OF PALEONTOLOGY, VOL. 15, NO. 2, PP. 153–156, PL. 26, MARCH, 1941

NEW MIDDLE EOCENE FORAMINIFERA FROM SOUTHERN ALABAMA AND MISSISSIPPI

J. B. GARRETT
Stanolind Oil and Gas Company, Houston, Texas[1]

ABSTRACT—Seven new species and one new variety of smaller foraminifera are described from surface and subsurface strata of southern Alabama and Mississippi. These forms have been found stratigraphically useful in the southeastern states. Specimens are figured from the Nanafalia formation, the Hatchetigbee formation, and the Enterprise marl.

CERTAIN undescribed species of Foraminifera found in middle Eocene beds of southern Alabama and Mississippi are of value in correlation. Some of these are described here. In so far as possible, specimens were taken from well known surface localities. A list of samples used, with their locations, follows:

Sample no. 102-B.—Sandy, glauconitic, fossiliferous marl in roadcut on the Camden-Fatama road, lying 4.1 miles southeast of the courthouse at Camden, Wilcox County, Ala. This locality is Nanafalia in age, and lies in the Grampian Hills. Sample taken about 5 feet below top of exposure.

Sample no. 106-C.—Light greenish gray, glauconitic marl with casts. This bed is about 3 feet thick, occurring in the face of the steep, main bluff at Hatchetigbee Bluff on Tombigbee River, Washington County, Ala. The bed lies just at the base of the Tallahatta formation.

Sample no. 108-D.—Taken at Hatchetigbee Bluff from the same bed as sample no. 106-C, but lying 100 yards down-stream.

Sample no. 112-D.—Gray, fossiliferous clay, taken from the face of a low bluff on the west bank of Tombigbee River at Lott's Landing, Choctaw County, Ala. This lies about one-half mile north of the bridge on Alabama Highway 10 (Butler-Dixon Mills Highway). Sample taken about 8 feet below top of exposure, and is Nanafalia in age.

Sample no. 126-A.—Green, sandy, glauconitic, fossiliferous marl taken from the bottom of a small ravine lying on the west bank of the Chickasawhay River and about 100 yards south of the highway bridge at Enterprise, Clarke County, Miss. This is the Enterprise marl of E. N. Lowe.

Core at 2708–2735 feet.—From South Mississippi Petroleum Company no. 1 Pearlie Morris, Lamar County, Miss. Light greenish gray, glauconitic marl, basal Tallahatta in age.

Core at 2735–2753 feet—From the same well as preceding. Gray glauconitic clay, Hatchetigbee in age.

Core at 2758–2776 feet.—From the same well as preceding. Gray clay, Hatchetigbee in age.

The generic name *Hemicristellaria* is used in this paper to cover species of a type whose correct classification is a source of argument at the present time. Some day the question may be settled. The only purpose of the present paper is to name some markers for stratigraphic work.

Species described here are not restricted in all cases to the formations from which the types were taken. This is particularly true of those figured from the Nanafalia formation. At the outcrop the microfauna of the Nanafalia is much better developed than that of the overlying Tuscahoma, but in the subsurface section their microfaunas seem a great deal alike.

A. D. Ellis, Jr. contributed much time and care to supplying the figures. C. F. Washburn helped greatly with collecting from the outcrops. Miss Winnie McGlamery, of the Alabama Geological Survey, gave valuable information concerning localities. M. C. Israelsky and A. R. Mornhinveg furnished comparative material from Mississippi. P. B. Williamson kindly permitted use of cores from South Mississippi Petroleum Company no. 1 Pearlie Morris.

[1] Published with the permission of the Stanolind Oil and Gas Company.

SYSTEMATIC DESCRIPTIONS

Family LAGENIDAE

Genus HEMICRISTELLARIA Stache

HEMICRISTELLARIA BRANTLYI

Garrett, n. sp.

Plate 26, figures 1a, b, 2–4

Test moderate to large in size, elongate, compressed, close coiled in the early portion, but rapidly uncoiling; periphery angular, having short spines at the sutures in the early portion, and developing a thin keel of clear material in the later portion; chambers numerous, usually 10–14 in adult specimens; sutures distinct, raised, of clear material, slightly curved, ornamented with raised beads, which tend to become elongate in the later portion of the test; wall smooth; apertural face smooth, narrow; aperture at the periphery, produced, radiate.

Dimensions of types from Nanafalia locality no. 102-B, Wilcox County, Ala., placed in the Louisiana State Univ. Museum; syntype (no. 1963), length, 0.82 mm., width, 0.55 mm., thickness, 0.35 mm.; syntype (no. 1964), length, 1.10 mm., width, 0.55 mm., thickness, 0.35 mm. Dimensions of types from Nanafalia locality no. 112-D, Choctaw County, Ala., placed in the Louisiana State Univ. Museum; syntype (no. 1962), length, 1.15 mm., width, 0.55 mm., thickness, 0.41 mm.; syntype (no. 1965), length, 0.52 mm., width, 0.31 mm., thickness, 0.20 mm.

Remarks.—Hemicristellaria brantlyi is very similar to *H. tuberculata* (Plummer), from which it probably evolved. It differs in being wider, more compressed, in having a more angular periphery, and in developing a clear keel. *H. brantlyi* also resembles "*Marginulina*" *fragaria* var. *texasensis* (Cushman) in the character of its ornamentation.

HEMICRISTELLARIA HATCHETIGBEENSIS

Garrett, n. sp.

Plate 26, figures 5, 6, 7a, b

Test large, elongate, moderately compressed, close coiled in the early portion, but rapidly uncoiling; periphery in well-preserved specimens having a thin, clear keel; chambers numerous, usually 8–12 in adult specimens; sutures distinct, moderately curved, strongly raised, of clear material; wall smooth, unornamented except for one to several narrow, high, longitudinal costae paralleling the periphery; apertural face smooth, narrow; aperture at the periphery, produced, radiate.

Dimensions of type from Hatchetigbee locality no. 106-C, Washington County, Ala., placed in the Louisiana State Univ. Museum: syntype (no. 1966), length, 1.0 mm., width, 0.66 mm., thickness, 0.43 mm. Dimensions of types from core at 2758–2776 feet from South Mississippi Petroleum Company no. 1 Pearlie Morris, Lamar County, Miss., placed in the Louisiana State Univ. Museum: syntype (no. 1967), length, 1.03 mm., width, 0.58 mm., thickness, 0.35 mm.;

EXPLANATION OF PLATE 26

FIGS. *1a–b, 2–4—Hemicristellaria brantlyi* Garrett, n. sp. *1a*, Side view; *1b*, apertural view, syntype (no. 1962); *2*, Side view of syntype (no. 1963); *3*, Side view of syntype (no. 1964); *4*, Side view of syntype (no. 1965), a young specimen. Nanafalia formation, Ala. ×45 (p. 154)

5, 6, 7a–b—Hemicristellaria hatchetigbeensis Garrett, n. sp. *5*, Side view of syntype (no. 1966); *6*, Side view of syntype (no. 1967); *7a*, Side view; *7b*, apertural view, syntype (no. 1968). Hatchetigbee formation, Ala. and Miss. ×40 (p. 154)

8a–b, 9—Hemicristellaria hatchetigbeensis Garrett var. *harrisi* Garrett, n. var. *8a*, Side view; *8b*, apertural view, holotype (no. 1969); *9*, Side view of paratype (no. 1970), a young specimen. Hatchetigbee formation, Miss. ×40 (p. 155)

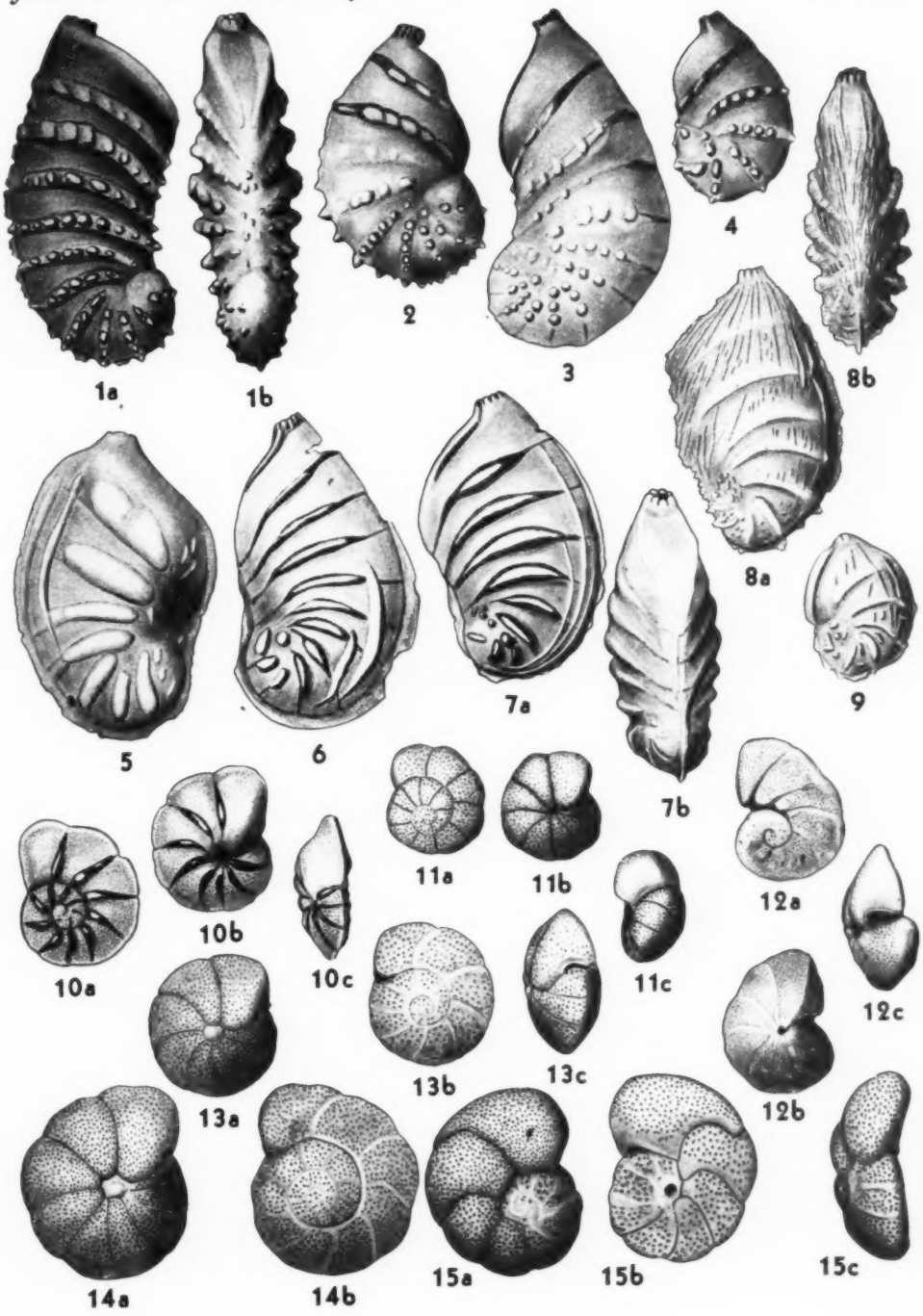
10a–c—Discorbis washburni Garrett, n. sp. *10a*, Dorsal view; *10b*, ventral view; *10c*, apertural view, holotype (no. 1971). Nanafalia formation, Ala. ×40 (p. 155)

11a–c—Gyroidina lottensis Garrett, n. sp. *11a*, Dorsal view; *11b*, ventral view; *11c*, apertural view, holotype (no. 1972). Nanafalia formation, Ala. ×55 (p. 155)

12a–c—Eponides lowei Garrett, n. sp. *12a*, Dorsal view; *12b*, ventral view; *12c*, apertural view, holotype (no. 1973). Enterprise marl, Miss. ×20 (p. 155)

13a–c, 14a–b—Cibicides hilgardi Garrett, n. sp. *13a*, Ventral view; *13b*, dorsal view; *13c*, apertural view, syntype (no. 1974). *14a*, Ventral view; *14b*, dorsal view, syntype (no. 1975). Greensand marl at base of the Tallahatta formation, Ala. and Miss. ×40 (p. 155)

15a–c—Cibicides williamsoni Garrett, n. sp. *15a*, Ventral view; *15b*, dorsal view; *15c*, apertural view, holotype (no. 1976). Nanafalia formation, Ala. ×40 (p 156)



Garret, Middle Eocene Foraminifera

UNIV. OF MICH.

syntype (no. 1968), length, 0.97 mm., width, 0.63 mm., thickness, 0.40 mm.

Remarks.—Hemicristellaria hatchetigbeensis resembles *Cristellaria vacavillensis* G. D. Hanna in general appearance, but is easily distinguished by the longitudinal costae parallel to the periphery.

HEMICRISTELLARIA HATCHETIGBEENSIS Garrett
var. HARRISI Garrett, n. var.
Plate 26, figures 8a, b, 9

This variety differs from the typical form in having numerous fine, high, longitudinal costae developed over most of the surface of the test, and in having narrower sutures.

Dimensions of types from core at 2735–2753 feet from South Mississippi Petroleum Company no. 1 Pearlie Morris, Lamar County, Miss., placed in the Louisiana State Univ. Museum: holotype (no. 1969), length, 0.95 mm., width, 0.55 mm., thickness, 0.34 mm.; paratype (no. 1970), length, 0.50 mm., width, 0.39 mm., thickness, 0.28 mm.

Family ROTALIIDAE
Genus DISCORBIS Lamarck
DISCORBIS WASHBURNI Garrett, n. sp.
Plate 26, figures 10a–c

Test small, compressed; periphery acute, lobulate in the later portion; composed of several whorls, chambers very slightly inflated, eight or nine in the final whorl; sutures slightly curved, raised, limbate, composed of clear material; wall smooth, covered with very fine punctations; aperture on the umbilical side of the periphery, with a very slight overhanging lip.

Dimensions of type from Nanafalia locality no. 112-D, Choctaw County, Ala., placed in the Louisiana State Univ. Museum: holotype (no. 1971), maximum diameter, 0.52 mm., thickness, 0.20 mm.

Genus GYROIDINA d'Orbigny
GYROIDINA LOTTENSIS Garrett, n. sp.
Plate 26, figures 11a–c

Test very small, biconvex; chambers inflated, eight or nine in the final whorl; periphery broadly rounded, slightly lobulate in the later portion; umbilical region on the ventral side depressed; sutures slightly curved, fine, rather indistinct, flush in the early portion, slightly depressed in the later portion; wall smooth, covered with numerous fine punctations; aperture an elongate, low arched opening at the base of the apertural face, extending from the periphery toward the umbilicus.

Dimensions of type from Nanafalia locality no. 112-D, Choctaw County, Ala., placed in the Louisiana State Univ. Museum: holotype (no. 1972), maximum diameter, 0.29 mm., thickness, 0.18 mm.

Genus EPONIDES Montfort
EPONIDES LOWEI Garrett, n. sp.
Plate 26, figures 12a–c

Test large, biconvex, dorsal side slightly convex, ventral side moderately so, with a small umbilical depression; periphery subacute; chambers indistinct, about 10 in number; sutures slightly curved, limbate, slightly raised; wall covered with punctations of moderate size; aperture a low opening between the periphery and the umbilical area.

Dimensions of type from Enterprise marl locality no. 126-A, Clarke County, Miss., placed in the Louisiana State Univ. Museum: holotype (no. 1973), maximum diameter, 0.97 mm., thickness, 0.43 mm.

Family ANOMALINIDAE
Genus CIBICIDES Montfort
CIBICIDES HILGARDI Garrett, n. sp.
Plate 26, figures 13a–c, 14a, b

Test of moderate size, biconvex, ventral side being moderately convex, dorsal side slightly so; periphery subacute; chambers distinct, eight or nine in the final whorl; sutures distinct, curved, limbate, of clear material, flush with the surface in the early portion, slightly depressed in the later portion; wall smooth, coarsely perforate, with a low, small, central node of clear material on the ventral side; aperture a low arched opening at the periphery.

Dimensions of type from Hatchetigbee locality no. 108-D, Washington County, Ala., placed in the Louisiana State Univ. Museum: syntype (no. 1974), maximum diameter, 0.49 mm., thickness, 0.25 mm. Dimensions of type from core at 2708–2735 feet from South Mississippi Petroleum Company no. 1 Pearlie Morris, Lamar County, Miss., placed in the Louisiana State Univ.

Museum: syntype (no. 1975), maximum diameter, 0.68 mm., thickness, 0.28 mm.

Remarks.—This species apparently is restricted to the glauconitic marl at the base of the Tallahatta, and to the upper part of the Hatchetigbee formation.

CIBICIDES WILLIAMSONI Garrett, n. sp.
Plate 26, figures 15a–c

Test small, dorsal side flat to slightly concave, ventral side moderately convex; periphery subacute, slightly lobulate; chambers distinct, seven to nine in the final whorl; sutures distinct, curved, limbate, raised in the early portion of the test, depressed in the later portion; wall coarsely perforate, central region on each side with a raised area of clear material; aperture a low opening at the periphery.

Dimensions of type from Nanafalia locality no. 102-B, Wilcox County, Ala., placed in the Louisiana State Univ. Museum: holotype (no. 1976), maximum diameter, 0.67 mm., thickness, 0.24 mm.

REFERENCES

COOKE, C. WYTHE, *1926*, Geology of Alabama; the Cenozoic formations, in: *Alabama Geol. Survey, Special Rept.* no. 14.

CUSHMAN, J. A., *1933*, Foraminifera, their classification and economic use: *Cushman Lab. Foram. Research, Special Pub.*, no. 4.

CUSHMAN, J. A., and HANNA, G. D., *1927*, Foraminifera from the Eocene near Coalinga, California: *Calif. Acad. Sci. Proc.*, 4th ser., vol. 16, no. 8, pp. 216–217, pl. 14, fig. 2.

GALLOWAY, J. J., *1933*, A manual of Foraminifera: *James Furman Kemp Memorial Series, Pub.*, no. 1.

HANNA, G. D., *1923*, Some Eocene Foraminifera near Vacaville, California: *California Univ., Dept. Geol. Sci., Bull.*, vol. 14, no. 9, p. 324, pl. 59, figs. 4a, b.

HANNA, G. D., and CHURCH, C. C., *1937*, Notes on *Marginulina vacavillensis* (Hanna): *Jour. Paleontology*, vol. 11, no. 6, pp. 530–531.

LOWE, E. N., *1919*, Mississippi, its geology, geography, soil and mineral resources: *Mississippi Geol. Survey Bull.*, no. 14, pp. 77–78.

LOWE, E. N., *1925*, Geology and Mineral Resources of Mississippi: *Mississippi Geol. Survey Bull.*, no. 20, pp. 68–69.

PLUMMER, HELEN JEANNE, *1926*, Foraminifera of the Midway formation in Texas: *Texas Univ. Bull.*, no. 2644, pp. 101–102, pl. 7, fig. 2; pl. 14, figs. 1a–c.

SMITH, E. A., and JOHNSON, L. C., *1887*, Tertiary and Cretaceous strata of the Tuscaloosa, Tombigbee, and Alabama Rivers: *U. S. Geol. Survey Bull.*, no. 43.

SMITH, E. A., JOHNSON, L. C., and LANGDON, D. W., JR., *1894*, Report on the geology of the Coastal Plain of Alabama: *Alabama Geol. Survey.*

MANUSCRIPT RECEIVED BY THE EDITOR SEPTEMBER 16, 1939.

JOURNAL OF PALEONTOLOGY, VOL. 15, NO. 2, PP. 157–159, PL. 27, 1 TEXT FIG., MARCH, 1941

A NEW GRAPTOLITE HORIZON IN WISCONSIN

CHARLES E. DECKER AND E. A. FREDERICKSON, JR.
University of Oklahoma, Norman, Oklahoma

ABSTRACT—It is purposed here to illustrate and describe a single species of graptolite from the Platteville limestone of Wisconsin, and to present illustrations for comparison of an identical species from the Criner Hills and Arbuckle Mountains of Oklahoma; to compare them with a similar form from the Ordovician of Sweden; and to present a brief section to show the position of the graptolite horizon in the Platteville limestone.

INTRODUCTION

THE JUNIOR author discovered a new graptolite horizon in the Platteville limestone, 3.8 miles north of Platteville, Wis. The senior writer later visited the locality during the summer of 1938, and collected a few additional specimens. The collection consists of a single species of graptolite, *Diplograptus* (*Amplexograptus*) *maxwelli*, which was named, illustrated, and described by the senior writer (Decker, 1935) six years ago from the upper part of the Bromide formation of the Simpson group, from sec. 35, T. 5 S., R. 1 E., at the south end of the Criner Hills, and from sec. 22, T. 2 S., R. 3 E., in the Arbuckle Mountains of Oklahoma. Later a form similar to *Diplograptus* (*Amplexograptus*) *maxwelli* Decker was recognized in Sweden by Ekström (1937, p. 37), who gave the senior writer credit, not alone for naming and describing the species, but also for suggesting its probable association in synrhabdosomes because of the radiating arrangement of the fragments in the tough limestone. In Sweden the forms occur in a shale, and 17 rhabdosomes were associated in a synrhabdosome.

The writers gratefully acknowledge the assistance of the American Association for the Advancement of Science for a grant through the Oklahoma Academy of Science, from which part of the expenses were paid for preparation of the paper and illustrations; they express their gratitude to Dean E. B. Fred, Graduate School, University of Wisconsin, for permitting the use of a list of fossils from the thesis by Carl Bays, and to Helen Tappan Loeblich for the pencil-shaded camera lucida drawings which she made with a Lapworth-Parkes graptolite microscope.

SYSTEMATIC DESCRIPTION

GRAPTOLOIDEA

AXONOPHORA Frech

DIPLOGRAPTIDAE Lapworth

Genus AMPLEXOGRAPTUS Elles and Wood, 1901–1918

DIPLOGRAPTUS (AMPLEXOGRAPTUS) MAXWELLI Decker, 1935

It is purposed here to use *Amplexograptus* for the genus in the sense that it was used by Elles and Wood (1901–1918, p. 221) for forms in which the thecae are semicircular in section, apertural margins undulate, and excavations are deep in obverse aspect.

The original description (Decker, 1935, p. 242) follows:

No complete rhabdomsome was secured and no synrhabdosome was clearly distinguished. Yet the crowding of so many rhabdosomes together in a small area with some of them apparently radiating from a center, makes it probable that synrhabdosomes did exist. They occur generally in a tough limestone from which it was difficult to secure more than small fragments.

The specimens illustrated in plate 1, figures 2–7, were collected from Rock Crossing in the Criner Hills. The one illustrated in 1, 1a was collected 1½ miles west of Nebo store, southwest of Sulphur. This largest fragment measures 21 mm. in length, and the entire length to which rhabdosomes grew is not known. The width at the sicular end is 1 mm. and this increases in a distance of six thecae to 2 mm. which is about the maximum width. A narrow line-like median depression occurs on the obverse side. The thecae number 10 to 14 in 10 mm. and overlap about ½ their length. Angle of slope is about 25 degrees. The margins are deeply notched. Two delicate lateral spines occur on the proximal end. The sicula, a little over 1 mm. long, may be seen in 6a.

With reference to the number of thecae given above, there are 10 to 12 in 10 mm. in the mature part of the rhabdosomes and as many as 14 in 10 mm. only in the proximal

region. The central virgellar spine is sometimes preserved, and it may be seen in figures 5, 6, 7, 14, and 15. It is slender and at times it seems slightly curved. Also, two lateral spines occur on the proximal end as shown in figures 2, 5, 6, and 14, and one lateral spine is preserved on 7 and 15. As to the origin of these lateral spines, Bulman (1938, p. 27) states that on the sicula

> opposite the virgella, the apertural margin of the metasicula may be entire, or it may bear one, or more, commonly two symmetrically placed apertural processes.

Possibly the spines shown on the right in figures 2, 5, and 14 may represent a secondary apertural extension on the sicula while the spines on the left in figures 2, 5, 6, 14, and 15 seem to be an apertural spine on the first theca budded from the sicula. The first seven figures are from forms in Oklahoma, and the other eight from Wisconsin. The specimens from the two regions correspond remarkably well in size and shape of the rhabdosomes and in size, shape and number of thecae. Also, the proximal spines are practically the same on the specimens from the two regions. The characteristics are so nearly identical that there is no question that they represent the same species.

However, after careful study of the illustrations by Ekström (1937, pl. 7, fig. 16; pl. 8, figs. 1–8) and of the specimens received from him, it is thought that the form identified by him as *Amplexograptus maxwelli* should be recognized as another species for the following reasons. While the number and form of the thecae correspond closely, the proximal end of the rhabdosomes differs greatly. Both by illustration and description the proximal end of the Swedish form is rounded, while the American forms are angular proximally. The Swedish forms have a long straight virgella, while in American forms the virgella is short and delicate. If present at all, lateral spines are very indistinct in the Swedish forms, while they are well developed on the American specimens. The Swedish forms have a strong medium septum and virgula, whereas they are rather indistinct in the American forms. Then, too, the Swedish form by association seems to represent a much earlier horizon. It is associated with *Didymograptus bifidus* and with *Phyllograpti* and seems to have rather a long range. The American species in both Oklahoma and Wisconsin has been found to range through only about five feet of limestone of Black River or upper Ordovician age. The zone of *Diplograptus* (*Amplexograptus*) *maxwelli* in Oklahoma is about 2000 feet above the regular *Didymograptus artus—D. bifidus* zone, and the *D. protobifidus—Phyllograptus* horizon is about 900 feet still lower in the section. Both of the latter zones are in the lower Ordovician.

Excellent complete rhabdosomes are available in Sweden where 17 of them were found associated in a synrhabdosome; and a long distal extension of the nema occurs on each form. No distal extension of the nema has been found on the American forms, as no entirely complete rhabdosomes have been secured.

Bays has reported the presence of graptolites in the Platteville formation in the city quarry at Lancaster, Wisconsin, NE. ¼, sec. 3, T. 4. N., R. 3 W., and in Pigeon Creek quarry, about 4 miles to the southwest in SE. ¼, NE. ¼, sec. 20, T. 4 N., R. 3 W. No specimens were available for detailed study although it is known that this material is poorly preserved.

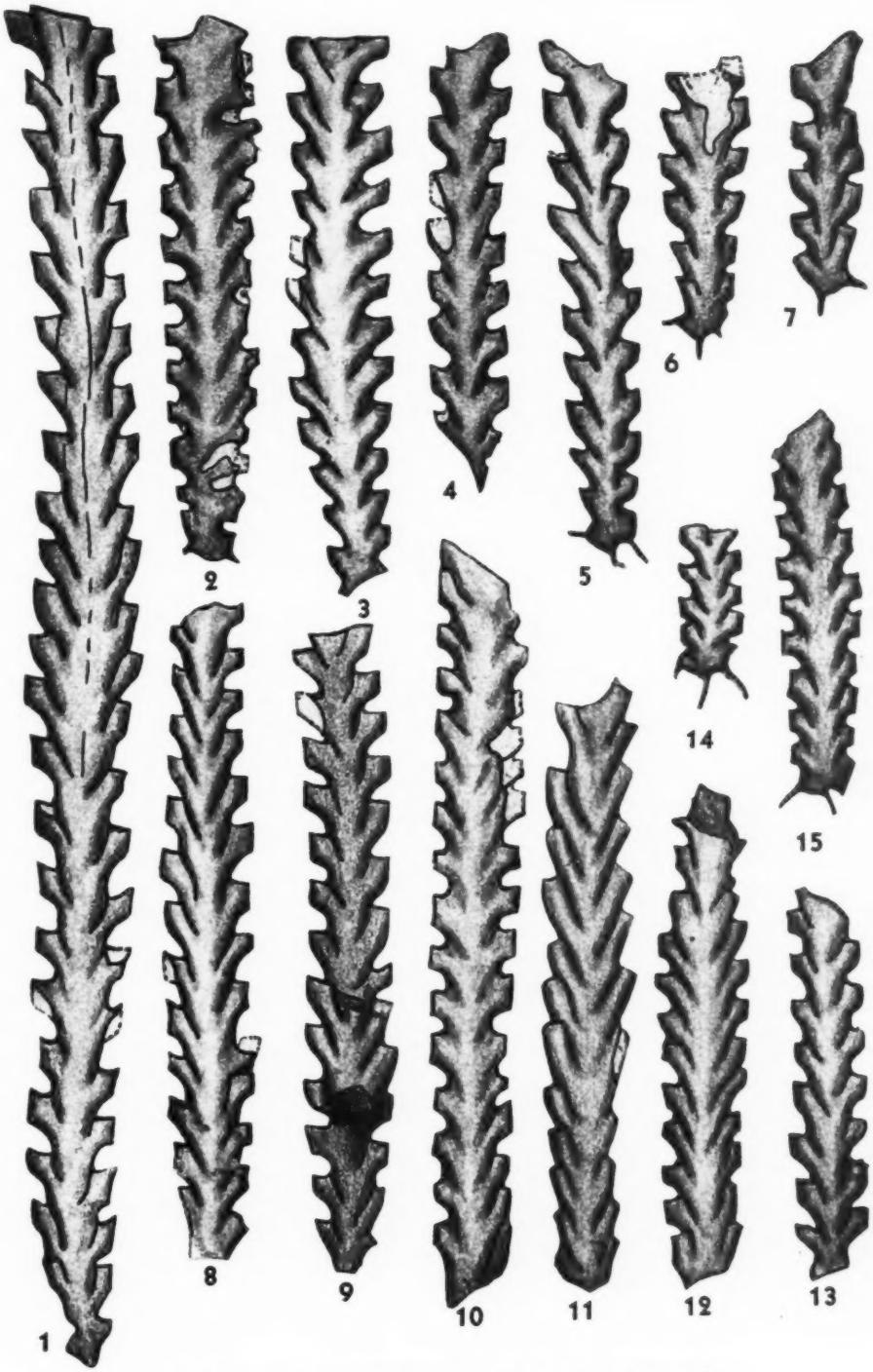
On the evidence of invertebrate fossils the Platteville formation has been correlated with the Bromide formation. Of the numerous fossils listed from the Platteville of

---

EXPLANATION OF PLATE 27

All figures ×8

FIGS. *1–15—Diplograptus* (*Amplexograptus*) *maxwelli* Decker. *1*, Specimen from the Bromide formation of the Arbuckle Mountains, west of Nebo Store, Syntype A-2041; *2–7*, from the Bromide formation, Criner Hills, Oklahoma. Syntypes *2*, A-2041, *3*, A-2051, *4*, A-2045, *5*, A-2047, *6*, A-2052, *7*, A-2053. *8–15*, from the Mifflin member of the Platteville formation, 3.8 miles north of Platteville, Wis. Homeotypes 8–15 bearing numbers in regular succession from A-2054 to A-2061 respectively. (p. 157)



Decker and Frederickson, Ordovician Graptolite

northern Illinois by Knappen (1926, p. 59), the following are common in the Bromide of Oklahoma: *Endoceras proteiforme, Gonioceras occidentale, Lingula elderi, Liospira progne, Orthis tricenaria, Plectambonites sericeus, Rafinesquina alternata, R. minnesotensis, Rhinidictya mutabilis, Scenidium anthonense, Strophomena incurvata, S. trentonensis, Thaleops ovata* and *Zygospira nicoletti*.

The finding of this new graptolite zone with *Diplograptus* (*Amplexograptus*) *maxwelli* in the Mifflin member of the Platteville formation ties it still more definitely with a zone about 25 feet below the top of the Bromide formation of Oklahoma.

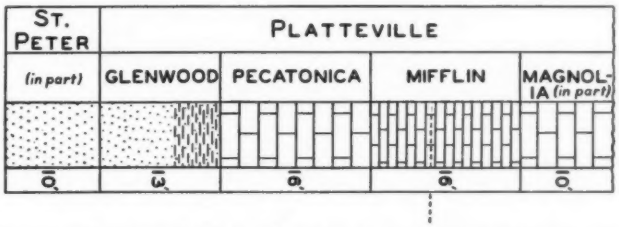


FIG. 1.—Section of Platteville Limestone, measured by E. A. Frederickson, 3.8 miles north of Platteville, Wis., on highway 80. In Wisconsin the Platteville formation has been divided into five members by Bays (1937) in ascending order as follows: Glenwood, Pecatonica, Mifflin, Magnolia, and Spechts Ferry. The section illustrates the conditions at the graptolite locality north of Platteville, Wis. At that locality the Spechts Ferry member is wanting and only part of the Magnolia is represented. The graptolites occur in the thin fossiliferous limestones six feet above the base of the Mifflin member, associated with brachiopods, bryozoa, pelecypods, gastropods, trilobites, and ostracods. The most common species as listed by Bays (1937, p. 125) are: *Hesperorthis tricenaria, Pianodema conradi, Rhynchotrema minnesotensis, Strophomena plattinensis, S. winchelli, Valcourea deflecta, Skenidoides anthonense, Eschapora subrecta, Ctenodonta compressa, Vanuxemia rotundata, Sinuites rectangularis, Thaleops ovatus, Leperditia germani, Schmidtella crassimarginata.*

REFERENCES

BAYS, CARL A., *1937*, The stratigraphy of the Platteville formation: *Ph.D. thesis*, University of Wisconsin.

BULMAN, O. M. B., *1938*, Graptolithina: *Handbuch der Paläozoologie*, Lief. 2, (Band 2 D) Borntraeger, Berlin, p. 27.

DECKER, CHARLES E., *1935*, The graptolites of the Simpson group: *Nat. Acad. Sci. Proc.*, vol. 21, pp. 239–243, pl. 1, figs. 1–6.

EKSTRÖM, GUNNAR, *1937*, Upper *Didymograptus* shale in Scania: *Sveriges geol. undersökning*, ser. C, no. 403, Arsbok 30 (1936), no. 10, pp. 37–39, pl. 7, fig. 16; pl. 8, figs. 1–8.

ELLES, GERTRUDE L., and WOOD, ETHEL M. R., *1901–1918*, A monograph of British graptolites: *Paleont. Soc. London*, p. 221.

KNAPPEN, R. S., *1926*, geology and mineral resources of the Dixon Quadrangle: *Illinois Geol. Survey, Bull.* 49, pp. 59, 60.

MANUSCRIPT RECEIVED BY THE EDITOR JULY 21, 1939.

JOURNAL OF PALEONTOLOGY, VOL. 15, NO. 2, PP. 160–163, 1 TEXT FIG., MARCH, 1941

CORRELATION OF CAMBRO-ORDOVICIAN TRILOBITES FROM OKLAHOMA

E. A. FREDERICKSON, JR.
University of Oklahoma, Norman, Oklahoma

ABSTRACT—Well preserved trilobites are abundant in limestone members in the lower one-fourth of the Arbuckle group and in the Timbered Hills group in the Arbuckle and Wichita Mountains, Oklahoma. A preliminary correlation of the fauna with the St. Croixan and Beekmantown faunas of the Upper Mississippi Valley is presented.

AN ABUNDANT trilobite fauna occurs in the lower formations of the Arbuckle group and in the Honey Creek formation of the Timbered Hills group in the Arbuckle and Wichita Mountains of Oklahoma. These trilobites range in age from Upper Cambrian to Lower Ordovician. A preliminary analysis of the fauna reveals many genera in common with the faunas of the Upper Mississippi Valley. Brief mention has been made of the occurrence of some of the genera by Bain (1900), Walcott (1914), Ulrich (1932), Bridge (1936a), and Bridge and Girty (1936), but a complete study of the trilobite fauna has not previously been attempted.

The problem was suggested by Professor Charles E. Decker of the University of Oklahoma in the spring of 1938 in connection with his work on the Timbered Hills and Arbuckle groups of the Wichita and Arbuckle Mountains, and the following field season was spent with him in the field. Acknowledgement is due Mr. Robert Dott and the Oklahoma Geological Survey for sponsoring the field work.

The classification of the Upper Cambrian and Lower Ordovician formations of Oklahoma used in this paper is that recently proposed by Dr. Decker (1939a). In figure 1, two fossil-bearing sections are illustrated. The section in the Arbuckle Mountains is the type section for the Honey Creek, Royer, and Butterly formations and is located along U. S. Highway 77 in the west part of T. 2 S., R. 2 E., Murray and Carter Counties, Oklahoma. The Wichita Mountain section is the type section for the Fort Sill, Signal Mountain and McKenzie Hill formations, and is located in sections 7 and 8, T. 2 N., R. 12 W., Comanche County, Oklahoma. A complete index section of the Timbered Hills and Arbuckle groups, of which the Arbuckle Mountain section illustrated represents approximately the lower one-third, is shown in the left hand corner of the figure. The Butterly and Royer formations are resistant, unfossiliferous dolomites. The former apparently does not occur in the Wichita Mountains, but the Royer formation has been recognized on the northwest edge of the mountains, thus suggesting a possible hiatus between the Fort Sill and Signal Mountain formations elsewhere in the Wichita Mountains (Decker, 1939b) unless the Royer dolomite horizon is represented by a limestone phase in those areas.

Another hiatus is suggested by the relative position of *Hystricurus* and *Symphysurina* in the two sections. Bridge (1936a, p. 981) has reported the occurrence of these genera, as illustrated in figure 1, in the McMichel member of the McKenzie Hill formation in the Arbuckle Mountains. He also has reported the presence of a Van Buren fauna of cephalopods and gastropods in the Chapman Ranch member which immediately overlies the Butterly dolomite. However, in the type section in the Wichita Mountains *Hystricurus* and *Symphysurina* occur together 16 feet above the base of the McKenzie Hill formation. No gastropods or cephalopods were observed. The absence of Van Buren forms and the presence of *Hystricurus* and *Symphysurina* so close to the base of the formation suggest the possible absence of the Chapman Ranch member in the southern edge of the Wichita Mountains. This suggested hiatus assumes added importance when it is realized that

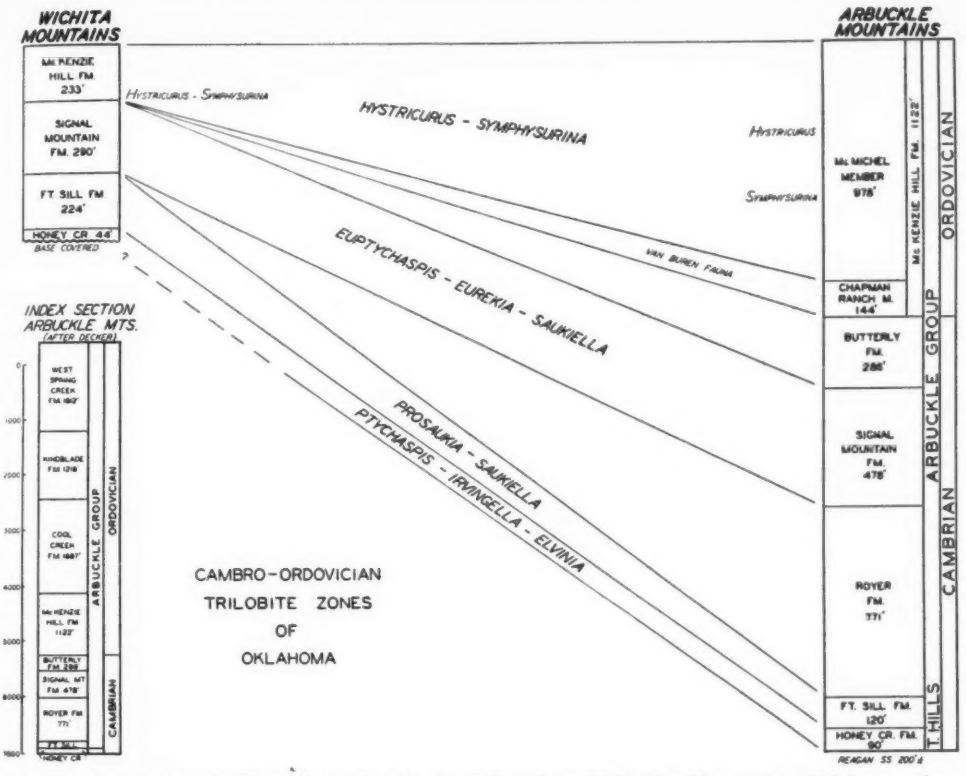


FIG. 1.—Composite stratigraphic sections in the Arbuckle and Wichita Mountains, Oklahoma, showing faunal correlation zones. Index section showing total thickness of Timbered Hills and Arbuckle groups in Arbuckle Mountains in lower left corner.

the *Hystricurus-Symphysurina* fauna is of Beekmantown age, whereas the fauna of the underlying Signal Mountain formation is of Upper Cambrian age.

In figure 1, the writer has designated for convenience faunal zones which appear to be characteristic of the formations in the two areas. The base of the Cambrian section in both the Wichita and Arbuckle Mountains is the unfossiliferous Reagan sandstone, which with the overlying Honey Creek formation forms the Timbered Hills group.

The St. Croixan trilobite faunas of Oklahoma and the Upper Mississippi Valley are strikingly similar in many respects. Table 1 presents a tentative correlation chart based on collections made in the summer of 1938. The faunal zones for the Upper Cambrian of Wisconsin were taken from Bridge (1936b), Howell and Lochman (1939), and Raasch (1939).

The Honey Creek formation is marked at the base by the *Camaraspis* fauna which correlates the basal portion with the Ironton member of the Franconia formation. Important trilobites in this fauna are *Camaraspis*, *Elvinia*, *Pterocephalia*, and *Irvingella major*. The middle portion of the Honey Creek is characterized by the *Conaspis* fauna, which includes *Conaspis*, *Taenicephalus*, and *Eoorthis*, and correlates this portion with the Goodenough member of the Franconia. As Ulrich (1932, p. 743) noted, the upper part of the Honey Creek is marked by several species of *Ptychaspis* which serve to correlate the top of the Honey Creek with the *Ptychaspis* zone of the Hudson member of the Franconia.

The Fort Sill formation does not contain as abundant a fauna as the Honey Creek. In the lower part of the formation recurs a species of *Irvingella* which is possibly conspecific with a Wisconsin form that recurs

TABLE 1.—TENTATIVE CORRELATION OF THE ST. CROIXAN AND BEEKMANTOWN OF WISCONSIN AND OKLAHOMA

FAUNAL ZONES		WISCONSIN		OKLAHOMA	
Hystricurus-Symphysurina	ORD.	Oneota dolomite			McKenzie Hill formation
Plethopeltis *Saukiella* *Eurekia-Euptychaspis*	UPPER CAMBRIAN	Trempealeau formation	Madison member	Arbuckle Group	Signal Mountain formation
			Jordan member		
Upper *Dikelocephalus*			Lodi member		
Platycolpus (*Scaevogyra*)			St. Lawrence member		
Lower *Dikelocephalus*		Franconia formation	Bad Axe member		Fort Sill formation
Briscoia *Prosaukia* *Ptychaspis*			Hudson member		
Conaspis			Goodenough member	Timbered Hills Group	Honey Creek formation
Camaraspis			Ironton member		
		Dresbach fm.	Galesville member		Reagan formation
			Eau Claire member		
			Mt. Simon member		?

in the same manner, indicating correlation of this lower portion with the *Prosaukia* zone of the Hudson member of the Franconia. *Platycolpus* occurs associated with an advanced species of *Prosaukia* and an early form of *Saukiella*, which according to Raasch[1] show St. Lawrence affinities, thus suggesting that the upper beds of the Fort Sill may be as young as basal St. Lawrence. *Briscoia* has been reported from the Fort Sill (Ulrich, 1932, p. 746), but the writer has not as yet encountered the genus in his collecting.

The Signal Mountain formation contains an abundant fauna of Trempealeau age. Characteristic genera are *Eurekia*, *Euptychaspis*, *Saukia*, *Corbinia*, *Calvinella*, *Stenopilus*, and *Saukiella*. *Plethopeltis* occurs in the upper portion of the formation in the Arbuckle Mountains. These genera suggest correlation of the Signal Mountain formation with the upper part of the St. Lawrence, and the Lodi, Jordan and Madison members of the Trempealeau formation. If, as suggested (Bridge, 1936, p. 236) the Lodi *Dikelocephalus* fauna is made up of forms that lived in the mud and are restricted to areas in which deposits are shales, the absence of this fauna is explainable.

The McKenzie Hill formation of the Wichita Mountains contains *Hystricurus* and *Symphysurina*. Both of these genera have been reported by Powell (1935) from the Oneota formation of Beekmantown age in Wisconsin and Minnesota.

[1] Raasch, Gilbert O., personal communication.

REFERENCES

BAIN, H. F., *1900*, Geology of the Wichita Mountains: *Geol. Soc. America Bull.*, vol. 11, p. 143.

BRIDGE, JOSIAH, *1936a*, Position of Cambrian-Ordovician boundary in section of Arbuckle limestone exposed on Highway 77, Murray County, Oklahoma: *Am. Assoc. Petr. Geologists Bull.*, vol. 20, pt. II, pp. 980–984.

——, *1936b*, The correlation of the Upper Cambrian sections of Missouri and Texas with the section in the Upper Mississippi Valley: *U. S. Geol. Survey, Prof. Paper* 186-L, pp. 233–237.

——, and GIRTY, GEORGE H., *1936*, A redescription of Ferdinand Roemer's Paleozoic types from Texas: *U. S. Geol. Survey. Prof. Paper* 186-M, pl. 68, figs. 19–22 and pl. 69, figs. 19–21.

DECKER, CHARLES E., *1939a*, Two lower Paleozoic groups, Arbuckle and Wichita Mountains, Oklahoma: *Geol. Soc. America, Bull.*, vol. 50, pp. 1311–1322.

——, *1939b*, Progress report on the classification of the Timbered Hills and Arbuckle groups of

rocks, Arbuckle and Wichita Mountains, Oklahoma: *Oklahoma Geol. Survey*, Circular no. 22.

HOWELL, B. F. and LOCHMAN, CHRISTINA, *1939*, Succession of late Cambrian faunas in the Northern Hemisphere: *Jour. Paleontology*, vol. 13, no. 1, pp. 115–122.

POWELL, LOUIS H., *1935*, A Study of the Ozarkian faunas of southeastern Minnesota: *St. Paul Institute Sci. Mus., Bull.* 1.

RAASCH, GILBERT O., *1939*, Cambrian Merostomata: *Geol. Soc. America, Spec. Paper* 19, p. 115.

ULRICH, E. O., *1932*, Preliminary description of the Honey Creek, Fort Sill, Royer and Signal Mountain formations of Oklahoma: *Geol. Soc. America, Bull.*, vol. 43, pp. 742–747.

WALCOTT, CHARLES D., *1914*, *Dikellocephalus* and other genera of the Dikelocephalinae: *Smithsonian Misc. Coll.*, vol. 57, no. 13, p. 378, 383.

MANUSCRIPT RECEIVED BY THE EDITOR JULY 1, 1940.

JOURNAL OF PALEONTOLOGY, VOL. 15, NO. 2, PP. 164–177, 5 TEXT FIGS., MARCH, 1941

PALEONTOLOGICAL NOTES

GRAPTOLITES FROM THE HARAGAN FORMATION (LOWER DEVONIAN) OF OKLAHOMA

CHARLES E. DECKER
University of Oklahoma, Norman, Oklahoma

ABSTRACT—At White Mound, about three miles southeast of Dougherty, Oklahoma, great numbers of fossils weather out on the surface of the loose Haragan marl. It is a famous collecting spot, and for nearly 40 years, thousands of geologists and students from a radius of 300 miles have gone there for collections. On a comparatively recent trip Perry Sollars dug from the side of the mound a piece of marly limestone on which there are parts of two colonies of a dendroid graptolite. Later, when accompanied by Sollars, the writer found two more species at the same locality. The three species are herein named, illustrated and described.

While graptolites occur in several horizons in the Arbuckle group, in two horizons in the Simpson group, throughout the Viola limestone and in the Fernvale, in the lower half of the Sylvan shale, and near the base of the Henryhouse shale, these are the first to be found in the Devonian of Oklahoma. Only 12 other species are known from the Devonian of America. Accordingly, these three new species from Oklahoma increase the total by one-fourth of those formerly known.

SYSTEMATIC DESCRIPTIONS

Class GRAPTOLITHINA Bronn, 1846;
emend. Lapworth, 1875
Order DENDROIDEA Nicholson, 1872
Family DENDROGRAPTIDAE
Roemer, 1897
Genus DICTYONEMA Hall, 1851

DICTYONEMA DELICATISSIMA Decker, n. sp.

While only a small part of a colony is preserved, enough of this beautifully delicate form is present to indicate its specific characteristics. The part preserved measures 9.0 mm. in length and 3.5 mm. in width. Thecae seen best near base of branches. Thecae are about twice as long as wide, 15 to 17 occurring in 10 mm., pointed at the distal end. Branches occur at intervals of 2.5 to 3.75 mm., and the meshes average 0.75 to 1.5 mm. in length and 0.75 mm. in width. Fine and hair-like dissepiments are well preserved.

Part of another colony of this species occurs on another slab of rock. This is a larger fragment, 19.5 mm. long and 7.0 mm. wide, but it is broken so that the stipes are not continuous.

Occurrence.—Lower Devonian, Haragan formation, equivalent to the New Scotland beds of New York.

Repository.—Mus. Inv. Paleon., Oklahoma Univ. Holotype no. A-2461.

DICTYONEMA SOLLARSI Decker, n. sp.

This species is named for Perry F. Sollars, whose resourcefulness in digging into the mound led to the finding of this new Devonian graptolite horizon.

The part of the colony preserved measures 9.0 mm. in length and 5.5 mm. in width at the widest part. It branches dichotomously at distances of 2.0 to 2.5 mm. and has meshes 4.0 mm. long and 1.25 mm. wide. Parts of three narrow dissepiments are preserved. The width of the stipes is about 0.5 mm., though they are wider below the point of divergence of the branches. The width of the thecae is about one-half their length and they number 18 in 10 mm. Narrow, elongate bithecae are developed. The presence of bithecae is significant in that they appear to be the latest known development of these structures. The significance of the bithecae is also enhanced by the suggestion that they, with the thecae, represent sexual dimorphism, and that the lack of bithecae is due to a transition to hermaphroditism. In a postscript to his article on

Graptolithina, Bulman[1] credits this idea to Kozlowski.

Occurrence.—Lower Devonian, Haragan formation, with the preceding *D. delicatissima.*

Repository.—Mus. Invert. Paleon., Oklahoma Univ. Holotype no. A-2462.

UNCERTAIN AFFINITIES

Genus CHAUNOGRAPTUS Hall, 1879

CHAUNOGRAPTUS GONOTHECATUS Decker, n. sp.

A very delicate colony which curves about and fragments of which branch sparsely. The stipes are hairlike, and the thecae are arranged differently on various parts. Occur on the surface of shells or free on the rock. Thecae tiny, about 0.5 mm. long and 0.3 mm. wide, 20 to 24 occurring in 10 mm. Two round gonothecae occur on the specimen shown in figure 1, C_2, and these give the name to the species. The thecae are shorter and more tiny than those on *C. gracilis* Clarke from the Lower Devonian of Quebec, and they are also less bottle-shaped.

Occurrence.—Lower Devonian, Haragan formation, with the two preceding species.

Repository.—Mus. Invert. Paleon., Oklahoma Univ. Cotypes no. A-2463.

Horizons and localities of other Devonian species.—Chaunograptus gracilis Clarke, Lower Devonian, Grand Gréve, Quebec; *Desmograptus becraftensis* Ruedemann, Lower Devonian (New Scotland Beds), near Hudson, New York; *Desmograptus vandelooi* Ruedemann, Middle Devonian, Hamilton Beds, Ontario Co., New York; *Dictyonema vadens* Hall, Middle Devonian (Hamilton Beds), Livingston Co., New York; *D. crassum* Girty, Lower Devonian (New Scotland Beds), Albany Co., New York; *D. fenestratum* Hall, Middle Devonian (Onondaga), Mackinac, Michigan; *D. hamiltoniae* Hall, Middle Devonian (Hamilton), Moscow, New York; *D. leroyense* Gurley, Middle Devonian (Onondaga), Genesee Co., New York; *D. megadictyon* Gurley, Middle Devonian (Onondaga), Genesee Co., New York; *D. perradiatum* Gurley, Middle Devonian (Onondaga), Genesee Co., New York; *D. splendens* Billings, Lower Devonian, Grand Gréve, Quebec; *Ptiograptus percorrugatus* Ruedemann, Lower Devonian (New Scotland Beds), Albany Co., New York.

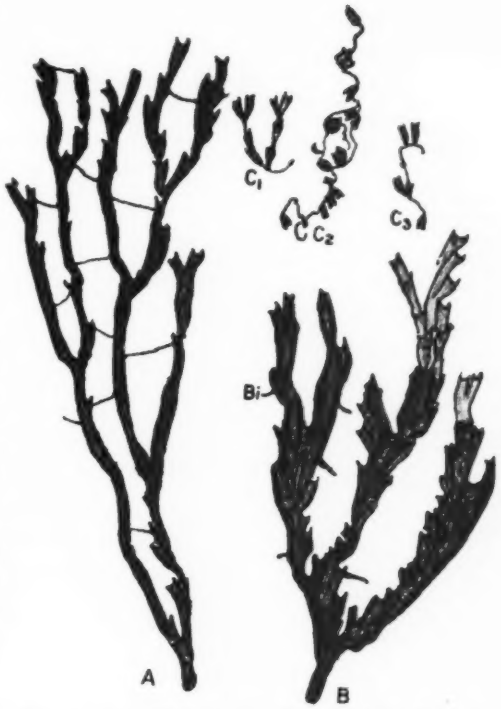


FIG. 1.—A, *Dictyonema delicatissima* Decker, n. sp. × 6, Delicate colony with thecae and dissepiments very well preserved.
B, *Dictyonema sollarsi* Decker, n. sp. × 6, showing thecae and elongate slender bithecae. Only fragments of dissepiments are preserved. Upper end is exfoliated.
C_1–C_3, *Chaunograptus gonothecatus* Decker, n. sp. × 6, C_1, Two branches of a colony showing thecae regularly developed; C_2, Larger part of a colony showing a few thecae and two gonothecae; C_3, Small part of colony showing thecae irregularly arranged.

[1] Bulman, O. M. B., *1938*, Graptolithina, in *Handbuch der Paleozoologie*, O. H. Schindewolfe, editor, Band 2D, p. 92 (published by Gebrüder Borntraeger, Berlin).

MANUSCRIPT RECEIVED BY THE EDITOR AUGUST 7, 1940.

THE SILURIAN OF AROOSTOOK COUNTY, NORTHERN MAINE

W. H. TWENHOFEL
University of Wisconsin, Madison, Wisconsin

ABSTRACT—The Silurian strata of Aroostook County, northern Maine, are situated in the region of Appalachian folding. Five units were defined by Williams and Gregory which were arranged as follows: Ashland limestone, Ashland shale, Sheridan sandstone, Graptolite shale, and Aroostook limestone.

Fossils listed from each of the stratigraphic units either contained many errors of identification, or there was mixing of fossils from different formations some of which could not be Silurian. For instance, the faunal list from the Ashland limestone contained 44 species of which 17 have never been found in Silurian strata.

The suggestion is made that the Aroostook limestone, of which only a part is limestone, may be Ordovician. Field relations and fossils suggest that the Graptolite shale and Ashland shale are parts of one stratigraphic unit, that the strata designated Ashland limestone are lenses of limestone in this shale, and that the Sheridan sandstone succeeds the Ashland shale. As thus interpreted, the section in descending order becomes: Sheridan formation, Ashland formation and Aroostook formation.

The aspect of the fauna is early Silurian, in the interval from late Clinton to early Niagaran. There are some faunal elements which suggest a slightly later age.

Aroostook county is in northern Maine adjacent to the International Boundary; it forms a part of the folded and faulted northern Appalachians. The strata of this part of the Appalachians are generally assumed to have been deformed in the Taconic disturbance at the close of the Ordovician and again in the Acadian movement of the late Devonian. It is certain that the strata have been rather intensely and intricately folded, intruded by lavas, and probably also faulted. It seems likely that the Devonian strata have unconformable relationships with the Silurian, although no contacts of the two systems of rocks in the region have ever been seen. There is a thick mantle of glacial drift, and exposures of non-resistant rocks are few. Volcanic and minor intrusive rocks have considerable development. Their age relations are not well known; some seem to be contemporaneous with Silurian and others with Devonian strata.

Some years ago, while engaged in compiling a correlation table of the Silurian strata of the St. Lawrence region, the writer studied the literature of that region for those areas of Silurian distribution with which he was not personally familiar. Among these areas was the Silurian district of Northern Maine. Work by Williams and Gregory (1900) furnished the chief source of information. Study of their results raised a number of questions for which no published answers were found. In the hope of finding the answers in the field, a trip was made to northern Maine in the summer of 1928. Through the assistance of Professor Charles Schuchert, contact was made with Mr. Olaf O. Nylander of Caribou, Maine. Mr. Nylander is an amateur naturalist who collected fossils from the Silurian and other strata of northern Maine long before the studies of Williams and Gregory. He assisted these geologists in their field studies and made some of the collections studied by Williams. Mr. Nylander also made collections for the New York State Museum. Under the guidance of Mr. Nylander, the exposures of fossiliferous Silurian strata were easily visited and a considerable collection of fossils was made. The field studies assisted in answering some of the questions that had been raised, but they also led to some difference of views from those expressed by Williams and Gregory.

The fossils studied by Williams have not been located. According to Dr. G. A. Cooper of the United States National Museum, there are very few fossils in the museum's collections from Silurian strata of northern Maine and there seem to be none from that region in the collections of Cornell University. The fossils studied and identified in this paper were collected by the writer or borrowed from the New York State Mu-

seum. Loan of the latter was made possible through the courtesy of Dr. Rudolph Ruedemann and Miss Winifred Goldring. In all, there are three small trays of fossils with a total of about 50 species.

PREVIOUS WORK

Fossils were collected and recorded from the Silurian and Devonian strata of northern Maine by Billings (1869) and Hitchcock (1862). The first work of a fundamental character dealing with these strata was that of Williams and Gregory. These authors described nine formations which in descending order are as follows:

9. Mapleton sandstone
8. Moose River sandstone
7. Chapman sandstone
6. Square Lake limestone
5. Ashland limestone
4. Ashland shales
3. Sheridan sandstone
2. Graptolite shales
1. Aroostook limestone

The Mapleton and Moose River sandstones were assigned to the Devonian, the other formations were assigned to the Silurian. It has long been recognized that the Chapman sandstone belongs to the Oriskany of the Devonian and the Square Lake limestone to the Helderberg of that system. Williams suggested "that the shales (in the Silurian section) are older than the limestones (*Ashland*) and that the Sheridan sandstones are the same age as the shales." The strata were correlated with the Clinton and Niagara. Shales below the Aroostook limestone were assigned to the Cambrian, but proof of this assignment was lacking.

DESCRIPTION OF THE SILURIAN STRATA

Exposures of the Silurian strata of northern Maine, with the exception of the Aroostook limestone, are few and small. The region is thickly mantled with glacial drift and one may travel for many miles without seeing a single exposure of a sedimentary rock. The sequence has never been deciphered with any degree of certainty and due to the intricacy of folding and the fewness of exposures, it is doubtful if the sequence can be worked out in detail. The extent of faulting is unknown. The structure has been further complicated by igneous intrusions. Even in the few large exposures there is difficulty in working out the succession because of close folding and repetition of strata. An exposure of the Aroostook formation in a road cut on the Aroostook River in Wade Township, Caribou Quadrangle, shows nearly vertical to overturned strata with the same units repeated several times. To render the problem still more difficult secondary cleavage in the shales and some of the limestones in places completely masks the bedding.

Aroostock formation.—Although the strata assigned to this division were termed the Aroostook limestone by Williams and Gregory, it is believed that the unit might better be called a formation, since in most exposures the limestone is quantitatively unimportant. Most of the rocks are shales, slates, and argillites.

The Aroostook formation has more and better exposures than any of the formations assigned to the Silurian. It may be seen in excellent exposures in cuts on the Bangor and Aroostook Railroad near Houlton (40 to 50 miles southeast of Presque Isle) and Presque Isle (fig. 1), in cuts between Presque Isle and Fort Fairfield (10 miles northeast of Presque Isle), and in a road cut on the river road west of Levine school in Wade township, southwest corner of Caribou quadrangle.

The strata of the Aroostook formation consist of interbedded shales, now mostly dark to black slates, siltstones (argillites), sandstones, and limestones. Siltstones dominate in some exposures, in others slates. Limestones in each case are absent, or present in only small amounts. Dark-blue limestone is the dominating rock in some exposures. Sandstones are not common. Beds of limestone range in thickness from very thin to as much as 10 feet. In some exposures the Aroostook limestones are filled with veins of calcite.

Fossils seem to be wanting or very rare in the Aroostook formation. Diligent search was made for fossils by Mr. Nylander and the writer and, except for problematical structures known as fucoids, none was found. Williams reported *Bilobites biloba*, a brachiopod similar to *Orthis elegantula* (now *Parmorthis elegantula*), and *Nucleo-*

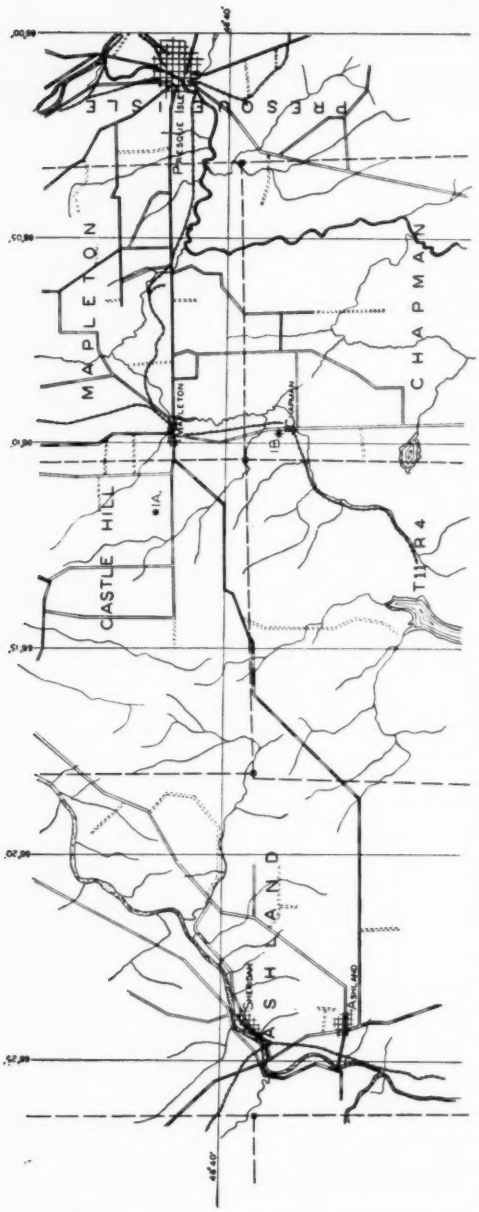


FIG. 1.—Type localities of the Silurian formations of Aroostook County, Maine.

spira pisiformis in "calcareous layers in Presque Isle and Mapleton"; traces of *Acidaspis* were seen. Mr. Nylander stated that he had never found any of these fossils and no fossils from this formation are in his collections or in the collections of the New York State Museum. The locality from which Mr. Nylander thought that Williams might have obtained the fossils listed above was diligently searched by Mr. Nylander and the writer and not a single determinable fossil was found. The strata at this locality are slates, and it is certain that anything collected from these rocks would be poorly preserved. As the fossils identified by Williams have not been seen one can do no more than speculate as to their identity. Fragments of fossils were seen in one exposure in the vicinity of Mars Hill about 20 miles southeast of Presque Isle. Considering the probable poor preservation of the fossils Williams had, it seems that it would have been very easy to have made mistaken identifications, particularly if examination of the fossils was approached from the point of view that they were of any particular age. The orthoid resembling *O. elegantula* may easily have been an Ordovician species, as shape must have been the only characteristic on which the identification could have been based. *Nucleospira pisiformis* may have been another species of similar shape, as shape again must have been the characteristic on which identification was based. *Bilobites biloba* could hardly have been mistakenly identified if the shell was well preserved, as the shape is so distinctive. But in view of the preservation, it is uncertain what the shell might have been which Williams identified.

Study of the strata of the Aroostook formation from a number of localities has left a very distinct impression that these strata have experienced a greater degree of deformation and metamorphism than have the younger strata that contain identifiable Silurian fossils. Unfortunately this impression could not be verified by comparison with higher strata in the same locality and at no place was a contact seen between the strata of the Aroostook formation and those of higher formations. If it is true that the deformation and metamorphism of the Aroostook formation are greater than in the higher strata belonging to the Silurian, it follows that there was an intervening interval of deformation. This may indicate that the Aroostook formation is not Silurian, but Ordovician, and that the meta-

morphism was produced in the Taconic disturbance. Militating against this suggestion are the fossils listed by Williams.

The thickness of the Aroostook formation is not known and there seems to be no way by which it can be determined.

As the stratigraphic position of the Aroostook formation can not be determined in Aroostook County either by relation to overlying and underlying formations, or by fossil content, there exists the possibility that it might be possible to determine position through study of the section on the near-by Chaleur Bay. Northrup has made a detailed study of the Silurian strata of that region. The Graptolite shale of the Aroostook County section contains a graptolite that suggests correlation with the Anse Cascon formation of the Chaleur section, thus suggesting that the Aroostook formation perhaps correlates with the underlying Clemville formation, the basal formation of the Silurian of the Chaleur Bay region. However, there is very little in the two formations to support such a correlation. The lithologies are very different and the fossil evidence in the Aroostook formation is questionable. The Clemville formation contains many of the common forms of Silurian colonial corals and if this formation correlates with the Aroostook formation, it would seem that some of these corals should be found in the Aroostook formation.

It is suggested that the Aroostook formation may correlate with some part of the Matapedia division (Ordovician) of Crickmay (1932) or the Whitehead (Cape Blanc) formation of Schuchert and Cooper (1930) as the strata of the Aroostook formation are not greatly unlike those of the Matapedia and Whitehead formations.

Graptolite shale.—The Graptolite shale was seen on the Littlefield farm in the western part of Chapman Township, Presque Isle quadrangle, where the strata are rather poorly exposed in field float; it is also exposed in small openings on a hillside on the west side of the Swanbank or Chapman Road, about three-fourths of a mile south of the north boundary of the township. The shale may also be seen under somewhat similar conditions of exposure on the Dudley farm a few miles west of Mapleton in the southeastern corner of Castle Hill Township, Presque Isle quadrangle. The Ashland limestone, or a limestone considered the equivalent of the Ashland limestone, is exposed at each place; it seems to lie beneath the Graptolite shale.

The Graptolite shale has dark colors and contains thin layers of siltstone and sandstone. The profile and section on the Duledy

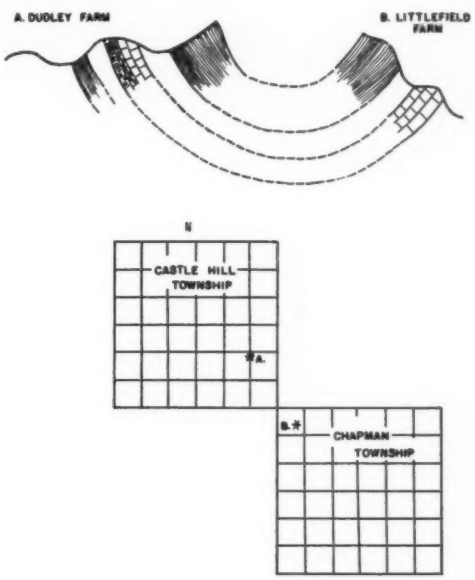


FIG. 2.—Diagrams showing position of the Silurian limestones and shales on the Dudley and Littlefield farms in Castle Hill and Chapman townships, Aroostook County, Maine.

farm are thought to be as shown in figure 2A, on the Littlefield farm as in 2B. The dip on the Dudley farm is thought to be to the east and the strike is nearly north-south. The exposures on the Littlefield farm are south and a little east of those on the Dudley farm, the strike is nearly north-south, and the dip is west. The dips in each case are between 70 and 80 degrees. The structure seems best interpreted as synclinal as shown in figure 2, made by uniting figures 2A and 2B; but it should be remembered that there is nothing on which to base an opinion of the structure other than these two exposures and they are several miles apart.

Some layers in the shale contain *Monograptus chapmanensis*, and Williams identified some structures as *Coleolus*. The writer has specimens of the graptolite, but it is not known what was identified as *Coleolus*. Williams also obtained a pelecypod which he identified as *Cardiola interrupta*. This identification was most certainly incorrect. The possible preservation would preclude certainty of identification and, at best, identification could have been little more than a guess based on shape. He also identified a cephalopod as *Orthoceras* cf. *virgulatum*. The fossil which Williams had must have been poorly preserved and the identification can hardly be given serious consideration. Farther north in the Stockdale quadrangle on the hill north of the town of Stockholm are dark shales and fine-grained sandstones which contain *Monograptus nylanderensis*. This fossil does not have general distribution in the strata, but it is found on the surfaces of some beds in abundance. The best places to collect are in the rock fences. Good exposures of slates and thin siltstones with their apparent bedding in vertical position are present on hills south of Stockholm. No fossils were found in these strata where they are in place. The relations to the shales containing *M. nylanderensis* are not known, but it is suggested that they are a part of the same stratigraphic unit and that these shales may correlate with a part of the Graptolite shale.

Ashland shale.—The Ashland shale is exposed about and in the village of Ashland on the western side of Ashland township, Ashland quadrangle. The shales extend southward toward Masardis on the southern edge of the Ashland quadrangle. They are also exposed below Ashland on the right bank of the Aroostook River. Fossils are rare or wanting in the exposures in Ashland village. This is thought to be due to metamorphism, as the shales have been changed to slates. Thin limestones near the contact with the Ashland limestone contain fossils.

Exposures of the strata assigned to the Ashland shale are uncommon and the best exposures seem to be those in Ashland village; they occur behind houses on the west side of the main north-south street. The strata consist of dark slates which become yellow to brown on weathering. They may also be seen on the east side of the same street where they consist of dark sandy shales, siltstones, and sandstones with an occasional thin limestone. The dip of these beds seems to be northwesterly and the exposed shales apparently overlie the Ashland limestone exposed to the rear of the houses on the east side of the principal street. About a mile south of Ashland on the Gilman farm, the Ashland shale is exposed in a field about one-half mile west of the north-south road. The exposures consist largely of field float, but it is quite obvious that some of this has been brought up by the plow from beds in place below. The section on the Gilman farm seems to consist of calcareous sandstones, siltstones, and limestone conglomerate.

Williams states that fossils were collected at Ashland from calcareous layers in the shale. (Species bearing names of fossils not found in the Silurian are omitted.)

Undetermined corals
Atrypa reticularis
cf. *Cyrtia* n. sp.
Leptaena rhomboidalis
Dolerorthis flabellites
Schuchertella subplana
Sowerbyella transversalis
Spirifer cf. *nympha*
Stropheodonta corrugata
Platyceras sp.
Calymene niagarensis

From the Winslow farm, about a mile south of Ashland.

Undetermined corals and brachiopods
Crinoid stems
Leptaena rhomboidalis
Parmorthis elegantula
Schuchertella subplana
Spirifer bicostatus
Stropheodonta perplana

Collections studied by the writer contain:

Clorinda linguifera
Leptaena rhomboidalis
Parmorthis elegantula
Eospirifer radiatus
Calymene cf. *schucherti*

It should be noted that the fossils listed from the Ashland shale are the same species as those from the Ashland limestone. It is also noteworthy that no graptolites have been found. As the fossils in the Ashland shale were derived not from shale beds, but from thin limestones, the absence of

graptolites may be explained as due to the fact that graptolites rarely are present in limestones and that the shales in the known exposures are too greatly metamorphosed to preserve graptolites.

Ashland limestone.—The type locality of the Ashland limestone is on the east side of the principal north-south street of the village of Ashland (fig. 1) where there is a small exposure in back of the houses. Another exposure is on the Gilman farm, about a mile south of Ashland. The latter exposure is in a field about one-half mile west of the road and the place of the exposure is in a thicket which is not cultivatable. Other rocks have been hauled from the fields into the thicket with the result that the Ashland limestone is almost hidden. Another exposure is on the Winslow farm in a field east of the north-south road and about 1.5 miles south of Ashland. According to Williams, it is the Ashland limestone which is exposed on the Dudley farm in Castle Hill township and the Littlefield farm in Chapman Township.

The Ashland limestone is hard, crystalline, and the color ranges from almost white to bluish-gray. No fresh exposures were seen, but it seems probable that such would show that the limestone occurs in thick beds. On the Dudley farm some of the rock has the appearance of being without true bedding. In places the rock is a conglomerate composed of limestone boulders, cobbles, and pebbles in a limestone matrix. Some beds have a brecciated appearance. Williams referred this to the deformation which the rock has experienced. The rock is a calcitic limestone.

The limestones seem to be of the nature of reefs or lenses in the associated shales. It is possible that there are two of these reefs or lenses: one at the Ashland exposures and another at the exposures on the Littlefield and Dudley farms. If there are two limestone units, it does not seem likely that they are separated by a great thickness of strata or by a great lapse of time.

Fossils are not uncommon in the Ashland limestone and in places fossils, particularly corals, are abundant. All specimens are rather strongly adherent to the matrix. Thirty-one species were identified by Williams from collections made in Ashland Village, 20 species from the Gilman farm, four from the Winslow farm, 13 from the Dudley farm, and four from the Littlefield farm. A total of 44 different species and varieties was identified by Williams. There are several incongruities in the list in that 17 species are not known to occur in American Silurian strata and most of these are from the Devonian. There are also some Silurian species listed which could not possibly be in association with the other listed Silurian species. Either there are several mistaken identifications, or collections from Silurian and Devonian strata were in some way mixed together.

Silurian fossils listed by Williams from the Ashland limestone at Ashland and vicinity are given below. It is not certain that the identification of these species is always correct and the chances are good that several identifications are erroneous. Names have been modernized and alphabetically and biologically arranged.

cf. *Diphyphyllum caespitosum*
Favosites niagarensis
Camarotoechia cf. *neglecta*
Coelospira hemispherica
Conchidium laqueatum
Eospirifer cf. *radiatus*
Leptaena rhomboidalis
Nucleospira pisiformis
Reticularia bicostatus
Rhynchospira cf. *globosa*
Rhynchotreta cuneata
Schuchertella subplana
Sowerbyella transversalis
Uncinulus stricklandi
Whitfieldella laevis
Whitfieldella intermedia
Whitfieldella nitida
Bronteus pompilius

Fossils listed by Williams from the limestones on the Dudley and Littlefield farms are—

Paleocyclus rotuloides
Atrypa marginalis
Conchidium nysius
Eospirifer radiatus
Leptaena rhomboidalis
Nucleospira pisiformis
Pentamerus oblongus
Sowerbyella transversalis
Arctinurus occidentalis
Dalmanites limuluris

The fossils from the two different areas of exposure of the limestones are sufficiently similar as to indicate that they probably belong to the same stratigraphic unit of the

Silurian. The limestones are also sufficiently alike to support the view that the correlation by Williams of the limestones about Ashland with those on the Dudley and Littlefield farms is probably correct.

As noted on an earlier page, the collections studied by Williams have not been located. The writer's studies of the fossils have been limited to the personal collections made with the assistance of Mr. Nylander and the collections borrowed from the New York State Museum. The complete list of the species identified by the writer is as follows.

Clathrodictyon vesiculosum
Enterolasma calycula
Favosites hisingeri
F. gothlandicus
Zaphrentis stokesi
Atrypa marginalis
A. reticularis
Bilobites biloba?
Clorinda linguifera
Coelospira hemispherica?
Conchidium knighti
Cyrtina exporrecta
Camarotoechia acinus
C. nucula
C. borealis
C. sp.
Dolerorthis flabellites
Eospirifer radiatus
Leptaena rhomboidalis
Parmorthis elegantula
Plagiorhyncha decemplicata
Rhynchotrema cuneata
Sowerbyella transversalis
Strophoprion geniculatum
Schuchertella alterniradiata
Spirifer cf. *sulcata*
Stricklandinia davidsoni
Whitfieldella nitida
W. oblata
Uncinulus stricklandi
Plethomytilus n. sp.
Pterinea sp.
Cypricardinia n. sp.
Diaphorostoma niagarensis
Platyceras niagarensis
Hormotoma sp. 1
H. sp. 2
Holopea n. sp.
Pleurotomaria sp.
Amphilichas shallopensis
Calymene schucherti
Cheirurus sp.
Cyphaspis cf. *christyi*
Dalmanites sp.
Encrinurus caplinensis
Eophacops orestes
Illaenus sp.
Proetus sp.

This is a total of 50 species and varieties, of which 37 are thought to be correctly identified and 13 are either new species or the material is in such condition as to render specific identification difficult or impossible. The aspect of the fossils is decidedly very high Clinton or low Niagara. *Coelospira hemispherica* and *Bilobites biloba* are doubtfully present.

Sheridan sandstone.—The composing particles of the Sheridan sandstone range from very fine sands to boulders with maximum dimensions of 6 to 8 inches. The larger particles are composed of quartz, jasper, slate, and various kinds of volcanic and plutonic rocks. Slate particles are very com mon in some beds. According to Williams, the deposits were made in a region subject to volcanic eruptions, or near such a region, as beds of volcanic ash and tuff are present. Colors are generally yellow, but some sandstones are nearly white.

Fossil material is not common and that present is generally fragmentary. Exposures are extensive and on the northern road from Presque Isle to Ashland (fig. 1) they may be seen to excellent advantage on the Sheridan farm, a short distance north of the southern boundary of Sheridan township. Another good exposure is below Ashland on the right bank of the Aroostook River a short distance below the entrance of Alder Creek. The sandstone is also exposed at the Frenchville store and church and in a quarry on the Allen farm about a mile west of the east line of Sheridan township. The best fossils seem to have been collected from piles of erratics which have been assembled by the farmers. Few are well preserved. Significant fossils identified by Williams are listed here. The complete list contains some species that are not known from Silurian strata. It is not known that the identifications of Williams are correct.

cf. *Enterolasma calycula*
Coelospira hemispherica
Eospirifer cf. *radiatus*
Leptaena rhomboidalis
Pentamerus cf. *oblongus*
Sowerbyella transversalis
Schuchertella subplana

The writer collected from the Sheridan sandstone at Frenchville, not far from Ashland, the following species:

Enterolasma calycula
Bryozoa
Atrypa reticularis
Parmorthis elegantula
Crinoid stems
Trilobite fragments

Williams considered the Sheridan sandstone a lateral equivalent of the Silurian shales which he believed to be older than the Ashland limestone. The writer's view, with respect to the limestones, is expressed above and it is considered probable that the Sheridan sandstone is sequential to the Ashland shale. This view also seems to be in accord with the structure. On the right bank of the Aroostook River, a few miles north and a little east of Ashland, the Ashland shale dips southeastwardly and is succeeded eastward and northward by sandstone and conglomerate of the Sheridan formation. This suggests that the sandstones are above the shales. However, this may not mean a great deal as exposures are not numerous and the structure is complex.

The aspect of the few fossils collected permits assignment of the Sheridan sandstone to the same general time unit as the Ashland shale, that is, high Clinton or low Niagara. *Coelospira hemispherica* was not seen by the writer and the other fossils have little significance other than to place the strata in the Silurian.

Succeeding strata.—Succeeding strata of the "Silurian" formations belong to the Devonian. The lowest unit is the Square Lake limestone, which carries a Helderberg fauna. This formation has a single exposure on the west shore of Square Lake in the southwestern quarter of Township 16 N., Range 5 E., about 30 miles north of Ashland (T. 11 N., R. 5 E.). The Square Lake limestone has not been seen in contact with any Silurian formation and thus structural relationships are not determinable from direct observation. The rock is a gray, very fossiliferous limestone that differs chiefly from the limestones in the Ashland formation in absence of brecciation. This might be considered as indicating deformation after the deposition of the Sheridan sandstone and before the deposition of the Square Lake limestone. As approximately 30 miles separate the exposure of the Square Lake limestone from an exposure of the Ashland limestone, it may be that the former was so situated in the deformation that brecciation did not take place. The later Chapman sandstone has not been seen in contact with the Square Lake limestone so relations are not determinable from exposures. The Chapman sandstone exhibits little metamorphism. This is in sharp contrast to the situation in the Silurian strata. Evidently movement took place between deposition of the Silurian and Devonian strata unless the Chapman sandstone happened to be in a place where movement was limited. Unfortunately at the places where the Chapman sandstone is exposed there are no exposures of Silurian strata.

Sequence of the formations.—The fossils identified by Williams from the Aroostook limestone indicate Silurian, but the certainty of poor preservation permits doubt of accuracy of identification and there is a possibility that the formation rightly belongs in the Ordovician. At any rate it seems certain that the Aroostook formation underlies unquestioned Silurian formations that have been described.

The sequence of the Silurian formations above the Aroostook formation is somewhat uncertain. Sections of the Ashland limestones and Graptolite shales on the Dudley and Littlefield farms show brecciated and conglomeratic limestones overlain by the so-called Graptolite shale. The common graptolite is *Monograptus chapmanensis*, a species related to *M. clintonensis*. These shales are thought to be younger than the limestones, although the strata may have been overturned. This does not seem to be the case. In the village of Ashland and vicinity, the limestones correlated with those on the Dudley and Littlefield farms are known as the Ashland limestones and the similarities are so strong that they are either the same limestone or lie as closely associated beds or lenses in the shales. At Ashland, the Ashland shale seems to lie above the limestones and this is the apparent positions at all three exposures. If this is the case, the Graptolite shale and the Ashland shale are parts of the same stratigraphic unit. The limestones are considered to lie in the shales in spite of the fact that Silurian shales have not been seen below the limestones. The descending sequence of

formations is thought to be as follows:

Sheridan formation (sandstone)

Ashland formation (shale and limestone)

Aroostook formation (limestone, siltstone, slate)

The fossils in the Sheridan and Ashland formations indicate middle Silurian. There is nothing indicating that strata of Medinan or Anticostian age is present. Most of the fossils indicate horizons above the Clinton, but if *Coelospira hemispherica* and *Bilobites biloba* are present, the presence of the Clinton is indicated.

In the Chaleur Bay region, it seems probable that the equivalents of the Ashland and Sheridan formations are the Anse Cascons, Le Vieille, and Gascons formations as these contain many of the species important in the Silurian of Aroostook County. The Ashland and Sheridan formations possibly find representation in the Chicotte formation of the Anticosti section, but it seems probable that most of the Aroostook County Silurian strata are higher than anything on Anticosti Island.

REFERENCES

BILLINGS, E., *1869*, Portland Soc. Nat. History Proc., vol. 1, pt. 2, pp. 104–126.

CRICKMAN, G. W., *1932*, Evidence of Taconic Orogeny in Matapedia Valley, Quebec: *Am. Jour. Sci.*, 5th ser., vol. 24, pp. 368–386.

HITCHCOCK, C. H., *1862*, Sixth Ann. Rept. Secretary Board of Agriculture, Augusta, Maine.

SCHUCHERT, C., and COOPER, G. A., *1930*, Upper Ordovician and lower Devonian stratigraphy and paleontology of Percé, Quebec: *Am. Jour. Sci.*, 5th ser., vol. 20, pp. 161–176.

SIPHONIDES, A NEW GENUS OF FORAMINIFERA

DAN E. FERAY

Montana School of Mines, Butte, Montana

The classic exposure of the Weches formation, Claiborne group, middle Eocene, on the south bank of the Colorado River, Smithville, Texas, consists of a series of fossiliferous, glauconitic marls separated by calcareous, limonitic, glauconitic ledges. The marls carry a rich foraminiferal fauna, from which *Textularia smithvillensis* Cushman and Ellisor and *Sigmoidella plummerae* Cushman and Ozawa have been named. The most prominent bed in the sequence is a hard, reddish-brown limestone, which forms a terrace and is composed largely of *Ostrea smithvillensis* Harris. The second marl below the oyster bed is about one foot thick and carries a rich and well-preserved fauna of Foraminifera, ostracods, and molluscs. This lithologic unit of the Weches formation[1] in this outcrop constitutes the type locality for *Siphonides biserialis* Feray, n. sp., the genotype of the new genus *Siphonides*.

Genus SIPHONIDES Feray, n. gen.

The diagnostic generic character of this genus is the biserial arrangement of the chambers that succeed the early typical siphonine coil. The aperture, which is typical of *Siphonina* on the coiled chambers, retains its siphonine form throughout the development of the test but occupies an eccentric position on the ventral side of, and close to, the periphery of each of the biserial chambers.

This new genus belongs in the subfamily Siphonininae of the family Rotaliidae and represents a specialized advance in the phylogeny of *Siphonina*.

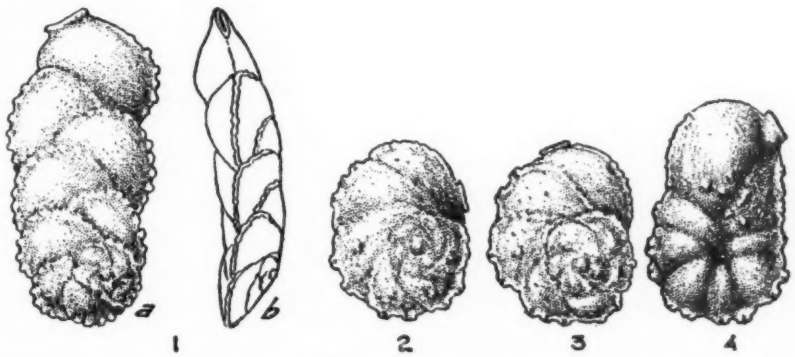
Genotype.—Siphonides biserialis Feray, n. sp.

[1] Stenzel, H. B., Sections at Smithville, Bastrop County, Texas: 12th Ann. Meeting, South Texas Geological Society, Log of Field Trip, pp. 12, 13, October 19, 1940. This graphic section accompanied by a brief description presents for the first time the detailed stratigraphic sequence in this exposure and shows the Tyus, Viesca, and Zilpha members. The oyster bed in this succession is bed II-d, Viesca member; the marl carrying *Siphonides biserialis* Feray, n. sp., is bed I-f, Tyus member.

SIPHONIDES BISERIALIS Feray, n. sp.
Text figures 1–4

The very small, strongly compressed, elongate, slightly lobate, and coarsely punctate test consists of a typical small siphonine coil followed by a succession of several biserial chambers. The early coil comprises from one and one-half to two convolutions with five or six slowly enlarging and very faintly inflated chambers in the final convolution. The later biserial chambers are typically siphonine in shape, lie in a plane that is slightly arched ventrally, and increase in size almost imperceptibly, so that the series maintains an almost constant breadth approximately equal to the diameter of the early coil. The dorsal face is gently convex, and the sutures are almost flush with the general contour of the test. On the ventral side, the chambers are distinctly inflated and separated by depressed and non-limbate sutures that radiate from a small umbilical depression. The coarsely fluted periphery of each chamber, by the addition of a new chamber, immediately ventral to the peripheral edge, becomes in part a fluted limbate dorsal suture, which accentuates the visibility of the structure of the test. The aperture of the early coil is typically siphonine in form and position. The aperture of each biserial chamber is a narrow, elliptical opening with a delicate phialine lip on a very short neck lying in an eccentric position above the base of the septal face on the periphery.

Length of holotype, 0.21 mm.; breadth, 0.11 mm.; thickness, 0.07 mm. The characteristically arched plane of biseriality in this species is the result of the mode of addition of the chambers. In the early trochoid coil each new chamber is added slightly ventral to the preceding one. The biserial chambers are added in the same manner as those of the coil, the periphery of each chamber not being overlapped by the succeeding chamber. The successive addition of chambers ventral to the periphery causes arching of the plane of biseriality in a ventral direction. The last-formed chambers of exceptionally well-developed specimens exhibit a slight loosening of the biserial arrangement.



FIGS. 1–4.—*Siphonides biserialis* Feray, n. sp., ×200. 1. Holotype; *a*, Dorsal view showing the early siphonine coil followed by five biserial chambers; *b*, peripheral view showing the plane of biseriality arched ventrally. 2, Youthful test comprising the early siphonine coil and bearing the typical aperture in its characteristic position. 3, Early coil followed by the first biserial chamber, showing the aperture in its characteristic position for the biserial series. 4, Ventral view of a test bearing three biserial chambers. (Drawings by Helen Jeanne Plummer.)

The holotype and paratypes have been deposited in the Feray Collection. Other specimens have been contributed to the U. S. National Museum, American Museum of Natural History, Leland Stanford, Jr., University, Walker Museum (University of Chicago), British Museum, Dr. J. A. Cushman, Mr. Frederick Chapman, Mr. Arthur Earland, Lt.-Col. L. M. Davies, and Dr. A. Silvestri.

MANUSCRIPT RECEIVED BY THE EDITOR, NOVEMBER 13, 1940.

TYPE OF THE ORDOVICIAN OSTRACODE GENUS LEPERDITELLA

H. N. CORYELL AND HUBERT G. SCHENCK
Columbia University, New York City, and Stanford University, California

ABSTRACT—The genus *Leperditella* was proposed by E. O. Ulrich in 1894 with *Leperditia inflata* Ulrich as its type. Then later this genus was selected as the type of the family Leperditellidae. *Leperditia inflata* Ulrich was preoccupied so we introduce *Leperditia rex* to replace it as a type of the genus and family and to be expressed as *Leperditella rex* (Coryell and Schenck).

Before Ulrich (1892, p. 265) had named several of his ostracodes *Leperditia inflata*, Jones (1864, p. 54) had transferred *Cypris inflata* Murchison (1839, p. 84), a form quite unlike Ulrich's specimens, to the same genus, and published the new combination, *Leperditia inflata* (Murchison), as a new member of the specific list of *Leperditia*. Also in 1888 Etheridge (1888, p. 241) referred *Cythere inflata* Münster (1830, p. 65) to the genus *Leperditia*, using the specific name *inflata*. According to the Rules of Zoological Nomenclature, Ulrich should have given his species a name that had not occurred in the specific list of *Leperditia* before 1892. All three of these forms are biologically different. Murchison's and Münster's species may be designated as secondary homonyms, and Ulrich's species a primary homonym of a secondary position. The former two would have a priority claim on the specific name *inflata* in preference to Ulrich's species. Münster's species would have a priority claim on the specific name over Murchison's as long as these two were considered members of the same genus whether *Leperditia* or *Paraparchites*. We propose the new specific name *rex* for Ulrich's *Leperditia inflata* so that it would correct the homonymy in its primary relationship with the species of *Leperditia* and also be acceptable when it appears among the species of *Leperditella*. Our new combination can be presented primarily as *Leperdita rex* Coryell and Schenck. It will become also the type of the genus *Leperditella* Ulrich (1894, p. 636) and therefore assume a relatively prominent place in the classification of the thirty described species of that genus.

We wish to introduce this method of procedure in dealing with secondary homonyms or species that during their adjustments in classification develop secondary positions of primary homonyms. It will aid in minimizing the "wild orgy of renaming species" referred to by Henderson (1934).

In accordance with the code of ethics of the International Rules of Zoological Nomenclature, the matter of the homonymy treated in this note was called to the attention of E. O. Ulrich through the kind offices of R. S. Bassler, who wrote (July 17, 1940) that someone had written to Dr. Ulrich about changing the name, "but as he does not care to bother with it, you (Schenck) might as well rename it yourself whenever convenient." We are also grateful to Dr. Bassler for designating the holotype and for supplying us with an illustration. In 1892 E. O. Ulrich figured the interior view of the selected holotype, but it is our privilege to present for the first time a view of the exterior as photographed by Dr. Bassler.

SYSTEMATIC DESCRIPTION

Family LEPERDITELLIDAE
Ulrich and Bassler 1908

Genus LEPERDITELLA
Ulrich 1894

In the original description of the genus, Ulrich stated that the

> left valve is a little larger than the other (and) the free edges of the latter (fits) into a groove.

This was a character used in distinguishing *Leperditella* from *Leperditia* in which the right valve overlaps the left very distinctly. The orientation of the valves thus assumes considerable significance. It becomes the fundamental factor in differentiating two genera even though in this case as in most extinct forms the selection of the orientation depends primarily upon the comparison with a formerly oriented contemporary and ap-

parently related species rather than with reference to a living individual.

LEPERDITELLA REX
(Coryell and Schenck) new name.

Leperditia inflata ULRICH, *1892*, Am. Geologist, vol. 10, no. 5, p. 265, pl. 9, figs. 12–15. Not *Cypris inflata* Murchison, 1839, Silurian Syst., page 84, figs. A 1–3, = *Leperditia inflata*, Jones and Kirkby, British Assoc. Rep. for 1863 (1864) p. 80, = *paraparchites inflatus* Bassler and Kellett, 1934, op. cit., p. 426.

Leperditella inflata (ULRICH), BASSLER and KELLETT, Geol. Soc. America Spec. Paper 1, p. 374, with synonomy.

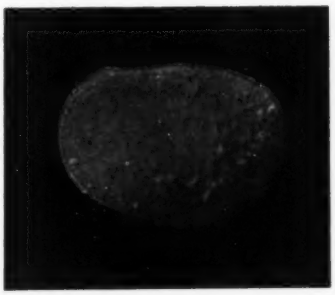


FIG. 1.—*Leperditella rex* (Coryell and Schenck) Exterior lateral view of the left valve of the lectotype, ×16.53.

Description.—Carapace is of medium size, subovate in lateral view; hinge contact is apparently simple and straight forming the dorsal margin in the anterior third but depressed below the convexity of the valves throughout the remaining portion; the dorsal margin in lateral view therefore appears straight in the anterior and arched upward in a broad curve in the posterior two-thirds; the posterior margin is more broadly curved ventrally than dorsally and forms the greatest posterior extension above the median line; the ventral border is broadly convex, with the most extended curvature slightly posterior of the middle; the anterior margin is rather regularly curved with the greatest extension near the mid-height; the greatest height and the greatest thickness are located in the posterior half of the valve; the convexity of the lateral surface of the valve is marked by numerous minor irregularities that appear to be allied to the preservation processes, otherwise the surface would be described as smooth; a broad, shallow, rather inconspicuous median sinus is present in the dorsal half of the valve. The interior free margin is grooved conspicuously to receive the right valve.

Type locality.—The specimen was collected near the bottom of the Kentucky River Gorge at High Bridge, Kentucky.

Age.—The formation was called originally the "Birdseye" limestone. It is now believed to be the Ridley "limestone" of the Stone's River group of the Ordovician.

Holotype.—The lectotype was selected from the syntypes at the United States National Museum by R. S. Bassler. It is the specimen illustrated by Ulrich (1892, pl. 9, fig. 12), and consists of a single left valve.

REFERENCES

BASSLER, R. S. and KELLETT, BETTY, *1934*, Bibliographic index of Paleozoic Ostracoda: *Geol. Soc. America, Special Paper* 1, pp. 500, 24 figs. in text.

ETHERIDGE, ROBERT, *1888*, *Fossils of British Islands*, vol. 1, p. 241, Oxford.

HENDERSON, JUNIUS, *1934*, *Our unstable biological classification and nomenclature.* Privately printed presidential address, fourth annual meeting of the American Malacological Union at Stanford University, pp. 13.

INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE, Opinions rendered, Dec. 16, 1925: *Smithsonian Misc. Coll.*, vol. 73, no. 3, pp. 40. (Opinion 83, pp. 8–10.)

JONES, T. R., *1864*, *Neues Jahrbuch*, p. 54, Stuttgart.

JONES and KIRKBY, *1866*, *Annals and Mag. Nat. History*, ser. 3, vol. 18.

JONES and KIRBY, *1886a*, *Geol. Soc. London Quart Jour.*, vol. 42.

JONES and KIRKBY, *1886b*, *Geol. Assoc. Proc.*, vol. 9.

JONES and KIRKBY, *1886c*, *Geol. Mag.*, dec. 3, vol. 3.

MURCHISON, R. I., *1839*, *The Silurian System*, Part, 1, pp. 576, Murray, London.

MÜNSTER, *1830*, *Neues Jahrbuch*, p. 65, Stuttgart,

SCHULZE, F. E. *et al.*, *1931*, *Nomenclator animalium generum et subgenerum*, Band 3, 14 Lief., p. 1795.

ULRICH, E. O., *1892*, New lower Silurian Ostracoda, no. 1: *Am. Geologist*, vol. 10, no. 5, pp. 263–270, 1 pl.

ULRICH, E. O., *1894*, The lower Silurian Ostracoda of Minnesota: *Minnesota Geol. and Nat. History Survey*, vol. 3, pt. 2, pp. 629–693, figs. 46–52, pls. 43–46. (Advance edition; vol. dated 1897.)

ULRICH, E. O. and R. S. BASSLER, *1906*, New American Paleozoic Ostracoda, Notes and descriptions of Upper Carboniferous genera and species: *U. S. Nat. Mus. Proc.*, vol. 30, pp. 149–164, 1 plate.

REVIEWS

INDEX OF PALAEOZOIC CORAL GENERA, by William Dickson Lang, Stanley Smith, and Henry Dighton Thomas, British Museum (Natural History), London, 1940. Price 15 shillings.

Any thoroughgoing study of a group of fossils must have as a preliminary foundation an exhaustive study into the work of earlier students. The earlier work may be said to have three aspects: first, the recording and demonstration of observed phenomena, second, the interpretation and classification of those phenomena, and, lastly, a nomenclature devised to express the phenomena and the interpretations put upon them. The names stand in our writings and in our minds as symbols of the phenomena, together with their many and varied implications and relationships to other phenomena. The present work deals not with phenomena nor with interpretations but with nomenclature, and to that division of nomenclature that applies to systematic units: more precisely it deals with the names of genera, of all genera to which Paleozoic corals have ever been referred. Indeed, the title might better have referred to generic *names* rather than to *genera* for genera as such are given almost no consideration. That will come later in other volumes not specifically announced, but definitely implied not only by the title but by an "Introduction" that discusses matters that are not at all pertinent to the strictly nomenclatural treatment that constitutes the present volume. The curious fact is that from a practical viewpoint one begins best the study of a group with a thoroughgoing survey of the generic *names* already in the literature. One first tries to discover all the names and, still working only with words, he tries to discover what species is actually the valid genotype of each name. This, with a very complete bibliography and a thorough documentation, is essentially what Lang, Smith and Thomas have done for the Paleozoic corals in this work.

It must not be supposed because the present work deals principally with names that it is unimportant. Indeed, it is of the highest importance as the first comprehensive step toward the illumination of that dark chaos that is the literature on Paleozoic corals.

In the words of Doctor Lang's introduction—"any work dealing with Palaeozoic corals must take account of every generic name that has been used to include any Palaeozoic coral species. The interpretation of a genus is absolutely conditioned by the genotype species; and it is the duty, in many instances the laborious duty, of the investigator to decide which of several genosyntypes is to be considered the genolectotype, to elucidate the genotype, and to determine the validity, or otherwise, and the status of each genus.

"Having established, as we have supposed, a satisfactory phylogenetic classification, the systematist must next apply a nomenclature, which must not only be logical but also legal"; . . . . "it is the generic names that must first be determined, and for this it is necessary to have a list of all the genera of Palaeozoic corals which have hitherto been published, together with their genotypes, whether already designated, or here first determined. Accordingly this volume contains such a list: it is the nomenclatorial foundation of all that follows."[1] I may add not only that it is a foundation for all that follows, but that it is a foundation which will be invaluable to all others who are working or contemplate working with Palaeozoic corals. Should no other part of the great work undertaken by the authors reach publication, the present part is still a contribution of very high value and great utility.

The authors profess to have made an effort to adhere to the International Rules of Zoological Nomenclature in carrying out their work, not at all an easy task owing to the well known ambiguity that characterizes the Rules at many points. This effort is highly to be commended, for we never can arrive at any uniformity of nomenclature unless some stable guiding principles are followed; and the Rules provide the only universally accepted set of such principles applicable. However, in one important point, they have chosen to disregard the

[1] The work under review, p. 8.

clear provision of Article 19 of the Rules, which provides that "The original orthography of a name is to be preserved unless an error of transcription, a *lapsus calami*, or a typographical error is evident." They have introduced numerous emendations of names not on the grounds of the purely mechanical errors covered by the provisions of the Rules, but on the ground that "the author's original orthography is not in accordance with its etymological derivation, or is at variance with the transliteration of Greek names given in the International Rules of Zoological Nomenclature."

The International Rules permit emendations in the orthography of names only in cases where purely mechanical errors are evident in the original publication of the name itself (Article 19 and Opinion 26). Several recommendations and Appendix F tell us how generic names should be formed and how Greek letters should be transliterated into Latin, but these are not themselves Rules. They are recommendations or counsel as to what procedure one should follow in forming names. In their very nature as recommendations they look to the future, not to the past. They should be followed by any careful worker, but they cannot be applied retroactively without nullifying the Rules themselves. The Articles of the Rules are phrased in terms of "must"; they are requirements that must be observed if names are to have validity or availability. The Recommendations are phrased in terms such as "It is well to avoid"—, "The following words may be taken"—, "The writer will do well to"—, etc.; they are suggestions, not requirements. To apply the recommendations retroactively can be done only at the cost of nullifying some Article of the Rules and of sacrificing the basic purpose of the Rules, which is to insure uniformity of usage.

There is in Recommendation *a*, under Article 8, a suggestion that the word "transcription," as employed in the Rules, may be interpreted also as "transliteration," and, in opinion 36 of the International Commission, covering a curious case, the suggestion is reinforced. But the basic purpose and philosophy of the Rules requires that "transcription" be interpreted in its strictest sense; that is, as "copying," and not as "transliteration" (change from one alphabet to another). This latter view is reinforced by Opinion 125, one of the latest to be issued, where the name *Borus* Agassiz, 1846, an admitted emendation of an error in transliteration in *Boros* Herbst, 1797, was held not to meet the provisions of Article 19 of the Rules, although under Recommendation *a*, Article 8 and Appendix *f*, Herbst should have written *Borus*. Although Commissioner Bather argued that Agassiz was "within his rights" (whatever that may mean) in making the emendation, he immediately admits that this "right" might be disputed, and states that "there is no possible question of an error of transcription." This seems to show clearly enough that emendations of errors of transliteration do not comply with Article 19 of the Rules, and that the term "transcription" as employed in that Article does not mean "transliteration." The summary of Opinion 125, following a principle established in Opinion 120, reads "*Borus* Agassiz 1846 is an emendation of, and therefore an absolute synonym of, *Boros* Herbst, 1797; *Borus* Albers, 1850, is a dead homonym." The principle established, stated in other words, is that an emendation undertaken contrary to Article 19 of the Rules strictly interpreted as to the meaning of "transcription" is (as established in Opinion 120) a junior objective synonym of the name in its original form. The name in its emended form, however, has power to preoccupy that form as a later name for another genus.

Returning to the work under review, we find numerous emendations contrary to the provisions of Article 19 of the Rules. These emendations cannot be employed legally under the Rules, but must eventually take their places as junior objective synonyms of the names in their original forms. Since, for a time there probably will be some paleontologists who will follow the authors of the work under review and employ the names in their emended form, and there certainly will be others who recognize the clear illegality of most of the emendations and who will not employ them, we have a dual set of names for Paleozoic corals. One will be employed by what may be termed "classicists" and the other by "legalists." This is just such a situation as the Rules are sup-

posed to avoid. The purpose of the Rules is to promote uniformity of usage. Classical purity is a secondary consideration entirely subordinate to fixity and uniformity.

In view of the numerous "corrections" of generic names by my good friends, the authors, may I be forgiven if I too lapse into pedantry so far as to point out that the English word "synonym" is frequently misused by them. Thus they write of *Actinocyathus*.[2] "This genus is a synonym [*sic*] of *Stylidophyllum*—," and many other instances of the same solecism occur throughout the work. It should be unnecessary to mention that the word "synonym" is correctly applied to indicate identity of meaning in words or names, not equivalence of nonverbal entities. One can say correctly, "*Actinocyathus* is the same genus as *Stylidophyllum* and the two names (for the same thing) are therefore synonyms," or even "*Actinocyathus* (meaning the name) is a synonym of *Stylidophyllum* (the name), but to say that a genus or a species is a synonym of another is essentially absurd, even though systematic "literature" abounds with this misusage.

It is indeed unfortunate that the authors, magnificent paleontologists all three of them, should have been so led astray by their understandable yearning for classical purity that they have not only introduced confusion into the orthography of the names of the Paleozoic corals, but they have lent the very considerable weight of the authority of their names and of the great Institution at which they work and which has published their results to what is a clear violation of the Rules of Nomenclature. It is to be hoped that their example in respect to emendations will not be followed with the inevitable confusion in nomenclature that is certain to result. In other respects their example is a model that may well inspire workers in fields other than the Paleozoic corals in most of which work of the same sort is very badly needed indeed.

J. Brookes Knight

Quantitative Zoology, by George G. Simpson and Anne Roe. 414 pp. 52 figs. Cloth. Price $4.00. McGraw-Hill Book Co., New York, 1939.

[2] Work reviewed p. 14.

It is almost axiomatic to say that every species varies, yet the quantitative description of variation within species of fossil animals has been almost entirely neglected. As a consequence, the great bulk of paleontological literature is of only limited usefulness in defining a species. This state of affairs has, in part, been due to the lack of a widely accessible source of statistical methods suited to use in paleontology. The appearance of this book is thus extremely welcome, especially since its senior author has been among the foremost of those to apply statistical methods to the study of fossils. The book can be best described by considering it in sections.

The first eight chapters are devoted to the theory and calculation of those various statistical properties of a sample of use to a zoologist or paleontologist. This section is well balanced and represents an eminently satisfactory condensation of this phase of the subject. Those, like the writer, who have been forced to wade through books on statistical analysis intended for economists will especially appreciate this section. It opens with a discussion of the types and properties of numerical data and of mensuration. The discussion of significant figures, which is introduced later, might well have been discussed here. Then follows a consideration of frequency distributions and groupings and their patterns. The accumulative curve perhaps is not given the attention it deserves, but otherwise the treatment seems complete. Measures of central tendency and dispersion and of variability are discussed next and quite adequately. The normal curve of variability is treated at some length; however, the method of obtaining a frequency curve from an accumulative curve, perhaps the best method, is omitted. (This method is covered in "Sedimentary Petrography" by Krumbein and Pettijohn.) Finally there is a good treatment of probability and reliability.

The second section treats of problems and theories of samples and sampling. The discussion of the use and limitations of small samples and single specimens is extremely valuable. The third section discusses the interpretation of statistical measures with respect to correlation, regression, association and significance.

The chapter on graphic methods will be found to be very useful in the presentation of statistical data. The book closes with a consideration of growth, a subject too much neglected in paleontology. There is a good bibliography, and the book is well indexed.

The illustrations are largely chosen from zoology and vertebrate paleontology, but the applicability of the methods to invertebrate paleontology will be appreciated by all who examine it. This book undoubtedly will be referred to by all those interested in the quantitative description of fossils and should be in the library of every paleontologist.

BENJAMIN H. BURMA

A CATALOGUE OF FORAMINIFERA, by Brooks F. Ellis and Angelina R. Messina. New York, American Museum of Natural History, 1940.

Members of the Department of Micropaleontology of the American Museum of Natural History have received most of the volumes of *A catalogue of Foraminifera* by Brooks F. Ellis and Angelina R. Messina. The Museum hopes to complete the printing of the entire work of 30 volumes in a short time.

The catalogue will consist of some thirty thousand pages of text and illustrative material. It will cover all published genera and species of Foraminifera. Each genus and species is treated as a separate unit. Generic units contain the type reference, a transcript of the original description, type species where designated by the original author, and a chronologically arranged list of subsequent references. Species units include the type reference, type figure, transcript of original description, type level and locality, depository, and chronologically arranged list of subsequent references. This material is arranged alphabetically by genera and species, and will be cross-referenced to indicate synonomy according to authors. To permit rearrangement and to provide for the insertion of newly published genera, species, and other supplementary material, which the Museum will publish later, it is bound in ledger type post binders.

The catalogue is but a part of a broad program of service through a Department of Micropaleontology having the following objectives:

1. To establish and maintain archives in which will be housed copies of all published works on Foraminifera, Ostracoda, and possibly Diatoms and Conodonts.
2. To publish catalogues of the genera and species of the various groups.
3. To establish a depository for types and faunas.
4. To establish and maintain a staff to study this material, to compile and issue the supplementary units needed to keep the catalogues up-to-date, and to make available the vast store of information contained in the archives (see membership benefits).
5. To make available to authors the services of artists and editors trained in this field of work.

The benefits of this program are available to all interested in this field of work through membership in the department. There are three classes of membership. Because of the limited number of copies of the catalogue, membership will be limited to three hundred.

Initial membership. The fee for this membership is $100. This entitles the member to a copy of the 30,000-page Catalogue of Foraminifera.

Continuing membership. One of the most basic services offered is that of keeping the Catalogue up-to-date. Supplementary material for new genera and species will be issued twice yearly. Continuing Members are entitled to a maximum annual increment of 500 species and genera. Continuing Members will also be entitled to access to the source material in the archives, either by visit or correspondence. This does not include inquiry service requiring extensive searches, or service involving the consumption of materials and supplies. Such searches will be made on request, however, and the charge therefore will be a nominal one. Photostats and photographs will be supplied at current prices. The annual dues for this type of membership are $25.

Active membership. Although the Catalogue will be a complete unit within itself, the field of its usefulness can be extended enormously by access to the source material in the Department. Active Members will be entitled to full access to this material as well

as the services of the entire Department. Expert searches are one of the special services offered. Services of artists and editors will be available at special low rates. Photostats and photographs of any portion of the source material will be available at special low rates. Supplementary units covering generic shifts and detailed synonymy will be issued as one of the benefits of this class of membership. Continuation is also included and entitles the Active Member to an unlimited annual increment of genera and species. The annual dues for this class of membership are $100.

This makes available to the present-day worker material impossible heretofore to obtain in such completeness, at a cost so unbelievably low, due to the contribution to this effort of many years of time and labor made possible both by public and private funds. It offers the first feasible and inexpensive means of keeping such a complete reference up-to-date. It makes available services which will make possible, for the first time, publications from many heretofore unable to do so for the lack of such services. Its compactness and clear reproduction offers incalculable savings of time in any effort involving the identification of Foraminifera and should be considered as an essential aid to any serious work in the field it covers.

For further information regarding the Catalogue or the work of the Department, or for application for membership, inquiries should be directed to the Department of Micropaleontology, American Museum of Natural History, Central Park West at 79th Street, New York City.

THE MAMMALIAN FAUNA OF THE WHITE RIVER OLIGOCENE, by William Berryman Scott and Glenn Lowell Jepson: PART III. LAGOMORPHA, by Albert Elmer Wood: *Transactions of the American Philosophical Society*, new series, vol. 28, pt. 3, pp. 271–362, 2 pls., 45 figs.

In the past the fossil Lagomorpha have received little attention and still less detailed comprehensive work. Prior to the above publication most of the information regarding this group was contained in a series of papers by Burke and Dice. Mr. Albert Wood's study of the lagomorphs of the White River Oligocene is an excellent summary of the scattered literature and a thorough review of considerable material. It follows the publication of Part II on the *Rodentia* of the same series also by Wood.

He gives a very detailed discussion of the genera *Palaeolagus*, *Megalagus*, *Desmatolagus*, and *Archaeolagus*. He synonymizes at least two genera and some dozen species, a step toward simplification that will be widely appreciated.

In this study he recognizes the following species:

1. *Palaeolagus haydeni* Leidy
2. *Palaeolagus temnodon* Douglass
3. *Palaeolagus burke*, n. sp.
4. *Palaeolagus intermedius* Matthew
5. *Palaeolagus hypsodus* Schlaikjer
6. *"Palaeolagus" primitivus* (Schlaikjer)
7. *Megalagus turgidus* (Cope)
8. *Megalagus brachyodon* Matthew
9. *Desmatolagus dicei* Burke
10. *Desmatolagus gazini* Burke

Mr. Wood gives careful attention to each of these species, including detailed descriptions of skeletal parts, phylogenetic position, and close comparison with recent forms of each of the lagomorphs occurring in the White River Oligocene. Although relationship has been suggested at one time or another between the lagomorphs and various other groups, nothing definite is known on the subject at the present time. He concludes that the question of their ultimate relationships is entirely buried in Eocene or earlier deposits, and little hope can be held for a solution of the problem until the discovery of lower Eocene lagomorphs, or, in case *Eurymylus* should prove to belong to the order, until after the discovery of good material in a Paleocene horizon, or even earlier.

CURTIS J. HESSE AND
RANDOLPH L. PETERSON

MANUEL DE PALÉONTOLOGIE ANIMALE, by Léon Moret, Paris: Masson et Cie., 1940, 675 pp., 241 figs., 12 Pls.

While a graduate student at the University of Grenoble, France, in 1924–25 the reviewer followed a most excellent course in paleontology taught by Professor Léon Moret. His lectures were thorough and comprehensive, and enjoyed a considerable fol-

lowing among the students of the University. Through the years Professor Moret has carefully selected his subject matter and the *Manuel* is essentially that course.

If the text appears to contain too much for the average college class in the subject it is because the tendency in French Universities is to give more extensive but fewer courses in the various fields; and in paleontology the teacher presupposes considerable training for his students in geology and in systematic biology. Upon such a foundation Professor Moret has succeeded well in writing a text not only useful to his students, but of value as well to the *savant* and the amateur.

The introduction (30 pages) is devoted to principles. Processes of fossilization, evolution, and methods and results are presented with sparkling clarity. The indispensability of paleontology to both geology and biology is forcefully championed. Moret's interpretation of the idea of orthogenesis will be frowned upon by many biologists and some paleontologists, but will be acclaimed by those who still feel that some factor other than natural selection is involved in definitely directed evolution. He believes that paleontology is a philosophical science and this point of view, established in the introduction, is retained throughout the text.

In the 460 pages devoted to the invertebrates and the 154 pages assigned to the vertebrates the author gives systematic descriptions of the principal groups susceptible of fossilization. These are presented from the point of view of the paleobiologist and are concise and attractively written. Most space is given to the invertebrates because they occur more extensively as fossils and are more easily collected and studied by the beginner than the vertebrates.

To some it may appear that the amount of space allotted to the various groups is not always well balanced. In this regard, however, the author has been guided by the relative importance and abundance of fossils in the respective groups, particularly in his area. This, no doubt, accounts for the considerable emphasis on types represented in Mesozoic and Tertiary sediments, and it is especially pleasing to find such an excellent chapter on the sponges, a group to which Professor Moret has contributed so much knowledge.

The vertebrate section, though short, is concise and well organized. The student will achieve a comprehensive view of the subject with the greatest economy of time and effort. The sections on the dinosaurs and primates are especially inspiring.

The book contains more than 2000 illustrations in 241 text-figures. They are all fine-line drawings by the author copied and adapted from many sources. They appear to be well selected, are done to emphasize significant features and are cleverly arranged to enhance the evolutionary and biologic point of view. The distribution in time and the phylogenetic relationships in the principal groups are illustrated in twelve plates. There is a list of figures and plates and an adequate index. Copious bibliographic references will be useful to those wishing to document themselves on any particular group.

The reviewer feels that Professor Moret's *Manuel* is singularly creditable and joins his many devoted students in congratulating him upon its completion. In the light of the events that followed its publication the simple statement in the preface becomes all the more poignant, and the book even more significant: "*Le destin a voulu gue ce livre, écrit dans un joyeux enthousiasme, s'achève dans la tristesse d' un nouveau bouleversement du monde.*"

GAYLE SCOTT

JOURNAL OF PALEONTOLOGY, VOL. 15, NO. 2, PP. 184–191, MARCH, 1941

SOCIETY RECORDS AND ACTIVITIES

MEMBERS OF THE SOCIETY OF ECONOMIC PALEONTOLOGISTS AND MINERALOGISTS

Honorary	3
Members	250
Associates	80
Total	333

*ADAMS, BRADFORD C., 929 South Broadway, Los Angeles, California

ADAMS, JOHN EMERY, Box 71, Gretna, Louisiana

ADKINS, W. S., Shell Oil Company, Inc., Shell Building, Houston, Texas

ALBRITTON, CLAUDE C., JR., Department of Geology, Southern Methodist University, Dallas, Texas

ALEXANDER, C. I., Geology Department, Magnolia Petroleum Company, Tyler, Texas

ANDERSON, FRANK MARION, 58 Hillcrest Road, Berkeley, California

ANDREWS, T. G., Box 2005, University of Alabama, University, Alabama

*APPLIN, ESTHER R., 2317 West Magnolia, Fort Worth, Texas

ARELLANO, A. R. V., Ejercito Nacional 81, Dept. 2, Tacubaya, D. F., Mexico

ARICK, MILLARD B., Ciudad Trujillo, Republica Dominicana

ARTUSY, RAY, 1831 Branard, Houston, Texas

ASZKLAR, STANLEY J., Gulf Research and Development Company, Box 852, Brenham, Texas.

BAKER, WILLIAM A., JR., 3218 Ewing St., Houston, Texas

BALL, JOHN RICE, Department of Geology, Northwestern University, Evanston, Illinois

BARBAT, WILLIAM F., Standard Oil Company, Bin XX, Taft, California

*BARKER, R. WRIGHT, Shell Oil Company, Inc., Shell Building, Houston, Texas

*BARNES, SYDNEY U., Standard Oil Company of Egypt, 22 Sharia Kasr el Nil, Cairo, Egypt

*BASSLER, R. S., U. S. National Museum, Washington, D. C.

BECK, R. STANLEY, Box 119, Bakersfield, California

BENNETT, ETHEL EVANS, 4903 Bryce Ave., Fort Worth, Texas

BENTZ, ALFRED, Institution of Petroleum Geology, Invalidenstrasse 44, Berlin, N.4, Germany

*BERMUDEZ, PEDRO J., Apt. 111, Ciudad Trujillo, Republica Dominicana

BERNARD, H. ALLEN, 519 West Main St., New Iberia, Louisiana

*BISSELL, HAROLD J., 853 East Third St., North, Provo, Utah

BORGER, HARVEY D., Standard Oil Company of Venezuela, Caripito, Venezuela, S. A.

BOWLES, EDGAR O., State Geological Survey, University, Alabama

BRADFIELD, H. H., The Texas Company, Box 1720, Fort Worth, Texas

BRADISH, BEVERLY B., Carter Oil Company, 514 Orpheum Building, Wichita, Kansas

BRAMLETTE, M. N., Department of Geology, University of California, Los Angeles, California

BRAMLETTE, W. A., Geology Building 105, University of Texas, Austin, Texas

BRANSON, E. B., Department of Geology University of Missouri, Columbia, Missouri

BRAUNSTEIN, Jules, Paleontological Section, Shell Oil Company, Inc., Houston, Texas

BREHM, CLARENCE E., 1720 West Broadway, Mt. Vernon, Illinois

*BRISTOL, HUBERT M., 107 South Harvey Ave., Oak Park, Illinois

BROUGHTON, M. N., The Texas Company, Box 951, Houma, Louisiana

*BROWN, IDA A., Department of Geology, University of Sydney, Sydney, New South Wales, Australia

CALAHAN, L. W., The Texas Company, Box 457, New Iberia, Louisiana

*CALDWELL, LOREN A., Northern Illinois State Teachers College, DeKalb, Illinois

CAMPBELL, ROBERT B., Peninsular Oil & Refining Company, 602 Wallace S. Building, Tampa, Florida

CANFIELD, CHARLES R., 1925 West 43d St., Los Angeles, California

*CARLSON, STANLEY A., Richfield Oil Corpo-

* Associate member.
† Honorary member.

ration, El Tejon Hotel Annex, Bakersfield, California

CHENEY, M. G., Anzac Oil Corporation, Box 446, Coleman, Texas

*CHILDS, THEODORE S., JR., Department of Geology, Stanford University, Palo Alto, California

CHURCH, CLIFFORD C., Tide Water Associated Oil Company, 79 New Montgomery St., San Francisco, California

*CLABAUGH, S. EDMUND, Department of Geology, University of Texas, Austin, Texas

CLARK, BRUCE L., Museum of Paleontology, University of California, Berkeley, California

CLARK, J. W., Magnolia Petroleum Company, Box 900, Dallas, Texas

CLIFTON, R. L., 1703 East Maple St., Enid, Oklahoma

COHEE, GEORGE V., State Geological Survey, Urbana, Illinois

COLE, J. GORDON, 3221 Hopkins St., Oakland, California

*COOMBS, HOWARD A., University of Washington, 112 Johnson Hall, Seattle, Washington

CORYELL, HORACE N., Columbia University, New York, N. Y.

COX, BEN BURTON, Socony-Vacuum Oil Company, 26 Broadway, New York, N. Y.

CRAM, IRA H., Pure Oil Company, 35 East Wacker Dr., Chicago, Illinois

CRONEIS, CAREY, Walker Museum, University of Chicago, Chicago, Illinois

*CRUME, ROBERT W., 1601 Center, Little Rock, Arkansas

CRUSE, JOHN S., JR., Amerada Petroleum Corporation, Houston, Texas

CUSHMAN, JOSEPH A., 76 Brook Road, Sharon, Massachusetts

*DEBLIEUX, CHARLES, Colombian Petroleum Company, Cucuta, Colombia, S. A.

DECKER, CHARLES E., Department of Geology, University of Oklahoma, Norman, Oklahoma

DEGOLYER, E., 1000 Continental Building, Dallas, Texas

*DENHAM, RICHARD L., Humble Oil & Refining Company, Midland, Texas

DEUSSEN, ALEXANDER, 1006 Shell Building, Houston, Texas

DICKERSON, ROY E., 39 Myrtle Ave. (Chatham Village), Upper Darby, Pennsylvania

DONOGHUE, DAVID, 1116 Fort Worth National Bank Building, Fort Worth, Texas

DORR, JAMES BRYAN, Shell Oil Company, Inc., Box 2099, Houston, Texas

*DREYER, FRANK E., Union Oil Company of California, Orcutt, California

DRIVER, HERSCHEL L., 630 West Palm Dr., Glendale, California

*DUNBAR, CARL O., Peabody Museum, Yale University, New Haven, Connecticut

DURGAN, HERBERT L., Seismograph Department, Sun Oil Company, Beaumont, Texas

DURHAM, J. WYATT, Department of Paleontology, University of California, Berkeley, California

*DUSENBURY, A. N., Iraq Petroleum Company, Ltd., Arrapha Camp, Kirkuk, Iraq

EDWARDS, EVERETT C., General Petroleum Corporation, Higgins Building, Los Angeles, California

*EDWARDS, KENNETH L., 6025½ 11th Ave., Los Angeles, California

*EICHER, DONALD B., Standard Oil Company of Egypt, 22 Sharia Kasr el Nil, Cairo, Egypt

EIFLER, D. K., JR., 2809 North Guadalupe, Austin, Texas

ELLIS, ALBERT D., Stanolind Oil & Gas Company, Box 3092, Houston, Texas

*ELLIS, BROOKS FLEMING, Department of Geology, New York University, New York, N. Y.

ELLISOR, ALVA C., Humble Oil & Refining Company, Drawer D., Houston, Texas

*EMEIS, J. D., Compania Petroleo de Shell, Bogota, Colombia, S. A.

*EMERY, KENNETH O., Department of Geology, University of Illinois, Urbana, Illinois

FABIANI, RAMIRO, Istituto e Museo di Geologia, Della R. Universita di Palermo, Palermo, Italy

FERGUSON, GLENN C., Union Oil Company of California, 1700 19th St., Bakersfield, California

FERGUSON, H. C., 1208 Esperson Building, Houston, Texas

FETTKE, CHARLES R., 1118 Wightman, Pittsburgh, Pennsylvania

*FISHER, LLOYD W., 59 Franklin St., Lewiston, Maine

FISK, HAROLD N., School of Geology, Louisiana State University, University, Louisiana

FLAGLER, C. W., Gulf Oil Corporation, 17 Battery Place, New York, N. Y.

FOREST, LESH, 446 North Gregory St., Whittier, California

*FRANKLIN, ELMER S., 2800 North Sichel St., Los Angeles, California

*FREDERICKSON, EDWARD A., Department of Geology, University of Oklahoma, Norman, Oklahoma

FRINK, JOHN W., 424 Riddle Road, Cincinnati, Ohio

*FRYE, JOHN C., U. S. Geological Survey, University of Kansas, Lawrence, Kansas

FUNKHOUSER, HAROLD J., Mene Grande Oil Company, Apt. 45, Puerta La Cruz, Venezuela, S. A.

GALE, ARTHUR S., JR., The Texas Company, Houston, Texas

GALLOWAY, JESSE J., Department of Geology, University of Indiana, Bloomington, Indiana

GARDNER, JULIA, U. S. Geological Survey, Washington, D. C.

GARRETT, J. B., JR., Stanolind Oil & Gas Company, Box 3092, Houston, Texas

GETZENDANER, F. M., 423 North Park St., Uvalde, Texas

GILES, ALBERT W., Department of Geology, University of Arkansas, Fayetteville, Arkansas

GILL, J. P., Sinclair Prairie Oil Company, Box 978, Ardmore, Oklahoma

GILLULY, JAMES, Department of Geology, University of California, Los Angeles, California

GLENN, LEONIDAS C., Department of Geology, Vanderbilt University, Nashville, Tennessee

*GOOCH, D. D., 112 Young St., Abbeville, Louisiana

GOODRICH, PAUL K., 2500 Esperson Building, Houston, Texas

GOUDKOFF, PAUL P., 799 Subway Terminal Building, Los Angeles, California

GRANT, U. S., IV., Department of Geology, University of California, Los Angeles, California

GRAVELL, DONALD W., Atlantic Refining Company of Cuba, 401 Edificio Metropolitana, Havana, Cuba

GREENE, FRANK C., 900 East 9th St., Kansas City, Missouri

GRIGSBY, R. B., Stanolind Oil & Gas Company, 1521 Charleston Ave., Mattoon, Illinois

GRILEY, HORACE L., Sun Oil Company, 1608 Walnut, Philadelphia, Pennsylvania

GRIMSDALE, T. F., Caribbean Petroleum Company, Maracaibo, Venezuela, S. A.

GULLY, PHILLIP D., 1903 Milam Building, San Antonio, Texas

HADLEY, WADE H., JR., Pure Oil Company, Box 1411, Baton Rouge, Louisiana

HALBOUTY, M. T., Merit Oil Corporation, Shell Building, Houston, Texas

HALSTED, MORRIS E., Amerada Petroleum Corporation, Houston, Texas

HAMILL, JAMES M., The Texas Company, 929 South Broadway, Los Angeles, California

HAMILTON, C. E., Box 5038, Farley Substation, Oklahoma City, Oklahoma

HAMILTON, I. B., 1901 Riverside Dr., Tulsa, Oklahoma

HANNA, G. DALLAS, California Academy of Sciences, San Francisco, California

HANNA, MARCUS A., Gulf Oil Corporation, Box 2100, Houston, Texas

HARLTON, BRUCE H., Amerada Petroleum Corporation, Box 2040, Tulsa, Oklahoma

HARRIS, REGINALD W., Department of Geology, University of Oklahoma, Norman, Oklahoma

HAWKINS, GLENN D., 423 South Allegheny, Tulsa, Oklahoma

*HAWKINS, HAROLD H., 36 Lock Lane, Apt. 6, Richmond, Virginia

HAZZARD, ROY T., Gulf Refining Company of Louisiana, Box 1731, Shreveport, Louisiana

HEDBERG, HOLLIS D., Mene Grande Oil Company, Apt. 45, Barcelona, Venezuela, S. A.

HENBEST, LLOYD G., U. S. National Museum, Washington, D. C.

*HENDRICKS, JOHN A., 6796 Milner Road, Hollywood, California

*HESSE, CURTIS J., Texas Agricultural & Mechanical College, College Station, Texas

*HIBBARD, RAYMOND R., 219 Bissell Ave., Buffalo, New York

†HILL, ROBERT T., Hotel Jefferson, Dallas, Texas

HOCKMAN, JAMES N., Box 280, Flora, Illinois

HOLLINGSWORTH, R. V., Walker Museum, University of Chicago, Chicago, Illinois

HONESS, CHARLES W., Gulf Refining Company, Box 774, Evansville, Indiana

HOOVER, W. F., 300 South 19th St., Mt. Vernon, Illinois

HORNBERGER, JOSEPH, JR., 2240 Inwood Dr., Houston, Texas

HOWE, HENRY V., School of Geology, Louisiana State University, University, Louisiana

*HOWELL, B. F., Department of Geology, Princeton University, Princeton, New Jersey

*HOUGH, JACK LUIN, Soil Conservation Service, Amarillo, Texas

*HUGHES, ADEN W., 1904 Brite St., Bakersfield, California

HUGHES, DONALD D., 1718 El Rito Ave., Glendale, California

HUGHES, URBAN B., 624 12th St., Laurel, Mississippi

*IKINS, WILLIAM C., 2608 McCallum Dr., Austin, Texas

ISRAELSKY, MERLE C., Union Producing Company, 841 M. & M. Building, Houston, Texas

JABLONSKI, EUGENE, Socony-Vacuum Oil Company, 26 Broadway, New York, N.Y.

JANOVY, JOHN, Louisiana Land & Exploration Company, Houma, Louisiana

JOHNSON, F. W., Lago Petroleum Corporation, Apt. 172, Maracaibo, Venezuela, S. A.

JOHNSON, J. HARLAN, Box 306, Golden, Colorado

*JOHNSON, WILLIAM R., Morrill Hall, University of Nebraska, Lincoln, Nebraska

*JONES, BRADFORD, C., Box 201, Palos Verdes Estates, California

*JORDAN, LOUISE, Anzac Oil Corporation, Coleman, Texas

JUNG, DOROTHY ANNE, Republic Production Company, Petroleum Building, Houston, Texas

KAUFMANN, GODFREY F., Standard Oil Company of Venezuela, Apt. 1329, Caracas, Venezuela, S. A.

KAY, G. MARSHALL, Department of Geology, Columbia University, New York, N. Y.

*KELLEY, FREDERIC R., Belvedere, California

KEMP, AUGUSTA HASSLOCK, Seymour Public Schools, Box 626, Seymour, Texas

*KING, RALPH H., 2239 West Drive, Lawrence, Kansas

KING, ROBERT EVANS, 401 North Big Spring St., Midland, Texas

KLEINPELL, ROBERT M., 502 Boulevard Alhambra Apt., 30 Dewey Blvd., Manila, P. I.

KNIGHT, J. BROOKES, Department of Geology, Princeton University, Princeton, New Jersey

KNIKER, HEDWIG T., 134 West Agarita Ave., San Antonio, Texas

KOCH, RICHARD E., 4, Willemslaan, Batavia-C., D. E. I.

KRUMBEIN, WILLIAM C., Department of Geology, University of Chicago, Chicago, Illinois

LAIMING, BORIS G., The Texas Company, 929 South Broadway, Los Angeles, California

LALICKER, CECIL G., Department of Geology, University of Oklahoma, Norman, Oklahoma

LEATHEROCK, CONSTANCE, 1324 South Utica, Tulsa, Oklahoma

*LEE, A. THEODORE, 2716 West 82nd St., Inglewood, California

LEVORSEN, A. I., 221 Woodward Blvd., Tulsa, Oklahoma

*LIEBUS, ADALBERT, Professor of Paleontology, Vinična 3, Prag, Czechoslovakia

*LIPSCOMB, VERNON F., Pure Oil Company, Box 2107, Fort Worth, Texas

*LOEBLICH, ALFRED R., Department of Geology, Tulane University, New Orleans, Louisiana

*LOWENSTAM, HEINZ A., Illinois State Museum, Springfield, Illinois

LUGN, ALVIN L., Department of Geology, University of Nebraska, Lincoln, Nebraska

LYNCH, S. A., Department of Geology, North Texas Agricultural College, Arlington, Texas

*MACFADYEN, W. A., Hope's Grove, Tenterden, Kent, England

MACNAUGHTON, LEWIS W., 1000 Continental Building, Dallas, Texas

MALKIN, DORIS S., 2508 Stanmore Dr., Houston, Texas

MANGER, G. E., Mene Grande Oil Company, Apt. 234, Maracaibo, Venezuela, S. A.

*MARKS, JAY GLENN, 153 South Gramercy Pl., Los Angeles, California

MARTIN, JAMES L., Department of Conservation, Louisiana State University, University, Louisiana

*MARTIN, LOIS T., 772 Santa Ynez Ave., Stanford University, California

MAY, ARTHUR R., 2615 22nd St., Bakersfield, California

MCCAMMON, JOHN HENRY, JR., Box 491, Mason, Texas

MILLER, A. K., Department of Geology, Iowa State University, Iowa City, Iowa

MILLS, LLOYD C., Pure Oil Company, Box 2107, Fort Worth, Texas

*MINCHER, ALBERT R., Route 2, Gulfport, Mississippi

MINTON, J. W., Sun Oil Company, McAllen, Texas

MISER, HUGH D., U. S. Geological Survey, Washington, D. C.

MONSOUR, ELI T., 1769 Lake Shore Dr., Shreveport, Louisiana

MONTGOMERY, J. C., Harrison Oil Company, Box 2279, Houston, Texas

MOORE, RAYMOND C., Department of Geology, University of Kansas, Lawrence, Kansas

MOORE, WILLIAM B., Atlantic Oil & Refining Company, Box 1346, Houston, Texas

MOREMAN, W. L., Magnolia Petroleum Company, Box 1828, Oklahoma City, Oklahoma

*MOREY, PHILIP S., Shell Oil Company, Inc., Shell Building, Houston, Texas

MORGAN, CHARLES GILL, 4608 Abbott Ave., Dallas, Texas

MORNHINVEG, A. R., Union Producing Company, Box 2492, Houston, Texas

MORRISON, T. E., Humble Oil & Refining Company, Box 2180, Houston, Texas

MORROW, A. LYNDON, Magnolia Petroleum Company, Box 426, Vanderbilt, Texas

MOSES, H. F., Carter Oil Company, Box 801, Tulsa, Oklahoma

MOSSMAN, R. W., Seismograph Service Corporation, 709 Kennedy Building, Tulsa, Oklahoma

MULLERRIED, F. K. G., Av. Mazatlan 208, Tacubaya, D. F., Mexico

MURRAY, GROVER, School of Geology, Louisiana State University, University, Louisiana

*NADEAU, BETTY KELLETT, 2572 West Point Dr., Maplewood, Missouri

NATLAND, M. L., 4155 Chestnut Ave., Long Beach, California

NEEDHAM, C. E., New Mexico School of Mines, Socorro, New Mexico

NEILL, W. B., Stanolind Oil & Gas Company, Box 3092, Houston, Texas

NEWELL, NORMAN D., Department of Geology, University of Wisconsin, Madison, Wisconsin

NICOL, DAVID, 4067 Mattison, Fort Worth, Texas

OLSSON, AXEL A., 48 Woodside Ave., Gloversville, New York

*OTTO, GEORGE H., 50 Club Dr., Greenville, South Carolina

OWENS, FRITH CRAVENS, Drawer 30, Corpus Christi, Texas

*PALMER, DOROTHY, Neptuno 1060, Havana, Cuba

PALMER, KATHERINE V. W., 206 Oak Hill Road, Ithaca, New York

*PARKER, FRANCES, 46 Carlton, Brookline, Massachusetts

PATTON, LEROY T., Texas Technological College, Lubbock, Texas

PAYNE, MAX, Richfield Oil Corporation, 312 Professional Building, Bakersfield, California

*PAYNE, THOMAS G., Walker Museum, University of Chicago, Chicago, Illinois

*PETTIJOHN, F. J., University of Chicago, Chicago, Illinois

PETTY, DABNEY E., Petty Geophysical Engineering Company, Drawer 1447, San Antonio, Texas

*PFANNKUCHE, MRS. H. C., 2428 Shirley, Fort Worth, Texas

*PIAZ, GIORGIO DAL, Direttore Istituto Geologico, Via Giotto 20, Padova, Italy

†PLUMMER, F. B., Bureau of Economic Geology, University of Texas, Austin, Texas

PONTON, GERALD M., 39 Fullerwood Dr., St. Augustine, Florida

POOR, R. S., Birmingham-Southern College, Birmingham, Alabama

PORCH, EDWIN L., JR., Box 573, San Antonio, Texas

PYEATT, LLOYD M., Atlantic Oil & Refining Company, Box 1346, Houston, Texas

REDFIELD, R. C., Kemper Military School, Boonville, Missouri

REED, EUGENE C., 1316 South 24th St., Lincoln, Nebraska

REESIDE, JOHN B., JR., Box 177, Hyattsville, Maryland

REINHART, PHILIP W., Shell Oil Company, Inc., 1008 West 6th St., Los Angeles, California

REITER, WILHELM A., 923 Esperson Building, Houston, Texas

REVELLE, ROGER, Scripps Institution of Oceanography, La Jolla, California

RICHARDS, J. T., Gulf Oil Corporation, Box 1557, Oklahoma City, Oklahoma

RIES, HEINRICH, Department of Geology, Cornell University, Ithaca, New York

RIGGS, ROBERT J., Stanolind Oil & Gas Company, Box 591, Tulsa, Oklahoma

*RIVERO, SENORA FRANCES CHARLTON DE, "Casa Blanca," Los Chorros (Estado Mirando), Venezuela, S. A.

ROLSHAUSEN, F. W., Humble Oil & Refining Company, Box 2180, Houston, Texas

ROMANS, WILLIAM A., Box 168, Baton Rouge, Louisiana

ROPER, FRANK CHARLES, 527 Esperson Building, Houston, Texas

ROSS, J. D., Marsman & Company, Inc., Box 3404, Manila, P. I.

RUSSELL, R. DANA, School of Geology, Louisiana State University, University, Louisiana

RYNIKER, CHARLES, Gulf Oil Corporation, Box 661, Tulsa, Oklahoma

SAMPLE, CHARLES HURST, Houston Oil Company, Box 2412, Houston, Texas

SANDIDGE, JOHN R., Magnolia Petroleum Company, 1704 Alamo National Building, San Antonio, Texas

SASS, LOUIS CARL, Kuwait Oil Company, Kuwait, Persian Gulf

SCHENCK, HUBERT G., Box 1528, Stanford University, Palo Alto, California

†SCHUCHERT, CHARLES, Peabody Museum, Yale University, New Haven, Connecticut

SCHWEERS, RICHARD HENRY, 4705 Byers, Fort Worth, Texas

*SCOBEY, ELLIS H., Box 482, Mattoon, Illinois

SCOTT, GAYLE, Department of Geology, Texas Christian University, Fort Worth, Texas

SEAGER, O. A., Carter Oil Company, Box 358, Bismarck, North Dakota

SEASHORE, P. T., 1026 Whitney Building, New Orleans, Louisiana

SELIG, A. L., Stanolind Oil & Gas Company, Box 3092, Houston, Texas

SELLARDS, E. H., Bureau of Economic Geology, University of Texas, Austin, Texas

SENN, ALFRED, British Union Oil Company, Box 177, Barbados, B. W. I.

SHAY, D. C., Box 941, Baton Rouge, Louisiana

SHOENFELT, C. E., Petroleum Information, Inc., Continental Oil Building, Denver, Colorado

SIDWELL, RAYMOND, Texas Technological College, Lubbock, Texas

SIEGFUS, STANLEY S., Socony-Vacuum Oil Company, C. A., Apt. 246, Caracas, Venezuela, S. A.

SIMON, LOUIS J., Superior Oil Company, Box 578, Shafter, California

SIMONSON, RUSSELL R., 211 Philippine St., Taft, California

*SIX, RAY L., Department of Geology, Oklahoma Agricultural & Mechanical College, Stillwater, Oklahoma

SMALL, WALT M., c/o Romano-Americana, Teleajen (Pleosti), Roumania

SMITH, FRED E., 841 M. & M. Building, Houston, Texas

*SMITH, JAMES, 1721 Bushnell, South Pasadena, California

SMITH, RALPH E., 904 College Avenue, Norman, Oklahoma

SMITH, R. HENDEE, School of Geology, Louisiana State University, University, Louisiana

SOHN, I. G., 2714 Wallace Ave., Bronx, New York

SPENCER, MARIA, Superior Oil Company, Box 510, Midland, Texas

SPIEKER, EDMUND M., Ohio State University, Columbus, Ohio

*STADNICHENKO, TAISIA, Department of the Interior, U. S. Geological Survey, Washington, D. C.

STAINBROOK, MERRILL A., Texas Technological College, Lubbock, Texas

STAUFFER, CLINTON R., Department of Geology, University of Minnesota, Minneapolis, Minnesota

STENZEL, H. B., Bureau of Economic Geology, University of Texas, Austin, Texas

STEPHENSON, LLOYD W., U. S. Geological Survey, Washington, D. C.

STEPHENSON, MORTON B., Stanolind Oil & Gas Company, Box 3092, Houston, Texas

*STEWART, DUNCAN, Carleton College, Northfield, Minnesota

STILL, J. T., 3 Oak Court, Houston, Texas

STUBBS, SIDNEY A., 628 West Call, Apt. 4, Tallahassee, Florida

STUCKEY, CHARLES W., JR., Stanolind Oil & Gas Company, Box 3092, Houston, Texas

STUDT, CHARLES W., Sagamore Oil & Gas Company, Independence, Kansas

*SUTTON, A. H., Department of Geology, University of Illinois, Urbana, Illinois

*SWARTZ, FRANK M., 722 North Atherton, State College, Pennsylvania

TAYLOR, RALPH E., Box 1520, New Orleans, Louisiana

TAYLOR, WILLIAM HARLAN, 713 Bankers Mortgage Building, Houston, Texas

TESTER, A. C., Department of Geology, State University of Iowa, Iowa City, Iowa

THOMAS, NORMAN L., Box 38, Bakersfield, California

*THOMPSON, MARCUS L., New Mexico School of Mines, Socorro, New Mexico

THOMPSON, S. A., Magnolia Petroleum Company, Box 900, Dallas, Texas

*THORP, E. M., Soil Conservation Service, Box 1898, Fort Worth, Texas

TIEJE, ARTHUR J., Cordova Hotel, 826 West 8th St., Los Angeles, California

*TOEPELMAN, WALTER C., University of Colorado, Boulder, Colorado

TOMLINSON, CHARLES W., 509 Simpson Building, Ardmore, Oklahoma

TRASK, PARKER D., U. S. Geological Survey, Washington, D. C.

TROWBRIDGE, A. C., 1182 East Court St., Iowa City, Iowa

TSCHOPP, H. I., Shell Oil Company of Ecuador, Ltd., Apt. 340, Quito, Ecuador, S. A.

TULLIS, EDWARD L., Department of Geology, South Dakota School of Mines, Rapid City, South Dakota

TWENHOFEL, W. H., Department of Geology, University of Wisconsin, Madison, Wisconsin

UPP, JERRY E., Amerada Petroleum Corporation, Box 2040, Tulsa, Oklahoma

UPSON, MARLIN E., Gulf Oil Corporation, Box 1290, Fort Worth, Texas

VAUGHAN, T. WAYLAND, 3333 P St., Washington, D. C.

WAGNER, CARL D., 2259 South Troost, Tulsa, Oklahoma

*WALDO, A. W., College of the Pacific, Stockton, California

WANLESS, HAROLD R., Department of Geology, University of Illinois, Urbana, Illinois

WARTHIN, ALDRED S., Department of Geology, Vassar College, Poughkeepsie, New York

WATERS, JAMES ALTON, Sun Oil Company, Box 2880, Dallas, Texas

*WATSON, ELIZABETH WATSON, Box 542, Stanford University, Palo Alto, California

WEAVER, CHARLES E., Department of Geology, University of Washington, Seattle, Washington

WEDEL, ARTHUR, Box 849, Santa Paula, California

WEEKS, H. J., Sun Oil Company, 1608 Walnut, Philadelphia, Pennsylvania

WEEKS, WARREN B., Phillips Petroleum Company, Box 1729, Shreveport, Louisiana

*WELCH, ROBERT N., State Geological Survey, University, Louisiana

WELLER, J. MARVIN, State Geological Survey, Urbana, Illinois

WELLMAN, DEAN C., Pure Oil Company, Box 271, Tulsa, Oklahoma

*WENTWORTH, CHESTER K., Honolulu Board of Water Supply, Honolulu, Hawaii

WESTHEIMER, JEROME MAX, 815 3d Ave. Southwest, Ardmore, Oklahoma

WESTMORELAND, FRANK S., 2311 Dunstan Road, Houston, Texas

WEYMOUTH, A. ALLEN, Box 295, Gisborne, New Zealand

WHIPPLE, G. LESLIE, Indian Oil Concessions, Ltd., No. 2 Bath Island Road, Karachi, India

WHITE, LUTHER H., Deep Rock Oil Corporation, Box 1051, Tulsa, Oklahoma

WHITE, MAYNARD P., Gulf Oil Corporation, Box 30, Ardmore, Oklahoma

WHITE, R. T., Route 3, Box 280-C, Bakersfield, California

*WHITELATCH, GEORGE I., Tennessee Division of Geology, State Office Building, Nashville, Tennessee.

WHITNEY, F. L., 2715 Splitrock, Austin, Texas

*WICKENDEN, ROBERT T. D., Geological Survey of Canada, Ottawa, Ontario, Canada

*WILLIAMS, JAMES STEELE, U. S. Geological Survey, Washington, D. C.

WINKLER, HANS, 104 West 32nd St., Austin, Texas

WINTON, W. M., Department of Geology, Texas Christian University, Fort Worth, Texas

WISSLER, STANLEY G., Union Oil Company of California, Box 511, Compton, California

WOODFORD, ALFRED O., 443 West 10th St., Claremont, California

WRATHER, W. E., 4300 Overhill Dr., Dallas, Texas

YARBOROUGH, HUNTER, JR., Humble Oil & Refining Company, Box 352, Hattiesburg, Mississippi

ERRATUM

An error appears in the index of the JOURNAL OF PALEONTOLOGY, vol. 13, pp. 621 and 622, relative to the paper by Helen Tappan "Foraminifera from the Grayson formation of Northern Texas." The Grayson formation is of Lower Cretaceous age, and references to a Tertiary age in the index are incorrect.

NOTICE

Extra plates of the Journal of Paleontology.—A number of separate copies of plates which have appeared in the "Journal of Paleontology" from volume 4, number 3, on are available at the headquarters of the Society of Economic Paleontologists and Mineralogists, P.O. Box 979, Tulsa, Oklahoma. The number of different plates available is over four hundred. They do not compose a continuous set. The plates may be purchased at the following prices: For orders from 1 to 10 plates, 10¢ per plate; for 11 plates, $1.02; for each plate above 11, add 2¢ to $1.02. No additional charge for postage, etc., will be made.

Bibliography of otoliths.—This work by Robert B. Campbell was published by the Society of Economic Paleontologists and Mineralogists in 1929 as Special Contribution No. 1.

A few copies are available at the headquarters of the Society of Economic Paleontologists and Mineralogists, P.O. Box 979, Tulsa, Oklahoma. The price is $1.00. Persons and libraries who wish to have a complete set of the publications of the Society would do well to obtain copies of this special publication before the supply is exhausted.

Catalog of North American early Tertiary fossils of the Gulf and Atlantic Coastal Plain.—This catalog to be published by the Bureau of Economic Geology, the University of Texas, Austin Texas, is prepared in a manner similar to the "Catalog of North American Devonian Fossils" published by the Wagner Free Institute of Science in Philadelphia.

The Early Tertiary catalog will contain descriptions and illustrations of the fossil invertebrates from the Paleocene, Eocene, and Oligocene of the Atlantic and Gulf Coastal Plain of the United States. Each species will be described and illustrated on a card of heavy paper 8½ by 11 inches in size, fitting a letter file. The text of the cards will be printed; the figures will be printed by full-tone collotype process. Type specimens will be figured if available; if not, photographs of topotypes will be used wherever feasible. Photographs of topotypes will be used extensively as supplementary illustrations. Original descriptions will be quoted in every case. Additional remarks or complete redescriptions will be given where necessary. Type localities and stratigraphic data have been checked in the field by specialists in nearly all cases and will be given explicitly and in an up-to-date manner. Therefore, the cards will contain much more information than is available in the literature today.

There will be running numbers for the whole catalog, one for each card. These numbers will begin with 1 and continue as long as new catalog cards are being published. Also, there will be running numbers restricted to each class. Thus the class Gastropoda will have its own numbering apart from the numbers for the entire catalog. The numbers will make it easy to arrange the cards and to refer to them in the literature.

The following cards are ready for publication:

Tetrabranchiate Cephalopoda (Nautiloidea)
28 species on 43 cards

Gastropoda—Genera *Cryptochorda* and *Lapparia*
12 species on 12 cards

Gastropoda—Family Turritellidae
81 species on 81 cards

Brachiopoda
27 species on 28 cards

The cards may be obtained from the Bureau of Economic Geology, Austin, Texas. Any further information will be furnished gladly.

OFFICERS OF THE SOCIETIES

SOCIETY OF ECONOMIC PALEONTOLOGISTS AND MINERALOGISTS

For the year ending April, 1941

President, CAREY CRONEIS, Chicago, Ill.

Vice-President, JOHN R. SANDIDGE, San Antonio, Texas.

Past-President, GAYLE SCOTT, Fort Worth, Texas.

Past-President, E. H. SELLARDS, Austin, Texas.

Secretary-Treasurer, HENRYK B. STENZEL, Austin, Texas.

Society Headquarters, 705 Wright Bldg., Tulsa, Oklahoma.

THE AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS

For the year ending April, 1941

President, L. C. SNIDER, Austin, Texas.

Past-President, HENRY A. LEY, San Antonio, Texas.

Vice-President, JOHN M. VETTER, Houston, Texas.

Secretary-Treasurer, ED. W. OWEN, San Antonio, Texas.

Editor, W. A. VER WIEBE, Wichita, Kansas.

Association Headquarters, 708 Wright Bldg., Tulsa, Oklahoma.

PALEONTOLOGICAL SOCIETY

For the year ending December, 1941

President, L. W. Stephenson, Washington, D.C.

Vice-President, H. G. Schenck, Palo Alto, Calif.

Secretary, H. E. VOKES, New York, N.Y.

Treasurer, ROBERT R. SHROCK, Cambridge, Mass.

Editor, C. WYTHE COOKE, Washington, D.C.

Councilors

C. O. DUNBAR, New Haven, Conn.

R. W. CHANEY, Berkeley, Calif.

C. W. GILMORE, Washington, D.C.

B. L. CLARK, Berkeley, Calif.

GEOLOGICAL SOCIETY OF AMERICA

For the year ending December, 1940

President, C. P. BERKEY, New York, N.Y.

Past-President, ELIOT BLACKWELDER, Stanford University, Calif.

Vice-President, DOUGLAS JOHNSON, New York, N.Y.

Vice-President, G. S. HUME, Ottawa, Canada.

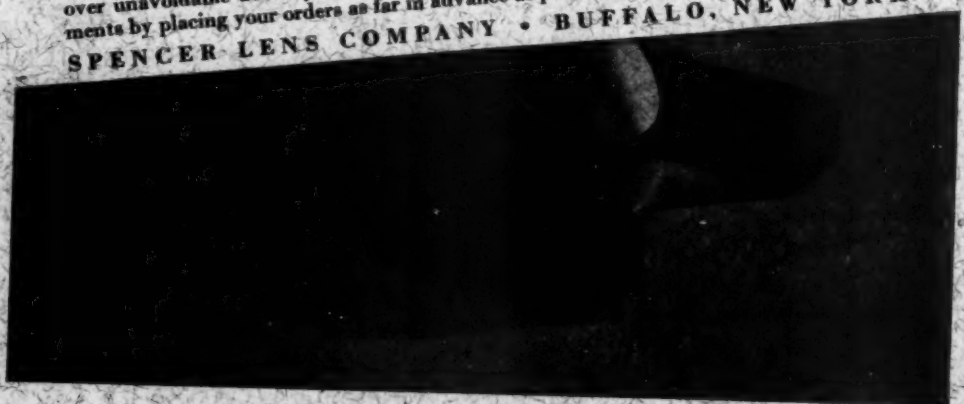
Vice-President, R. C. MOORE, Lawrence, Kan.

Vice-President, W. F. FOSHAG, Washington, D.C.

Secretary, H. R. ALDRICH, New York, N.Y.

Treasurer, E. B. MATHEWS, Baltimore, Md.

Society Headquarters, 419 West 117th St., New York, N.Y.

Some months ago Spencer announced a new group of Stereoscopic Microscopes embodying many notable improvements. • The demand for these instruments has far exceeded our output. Our greatly increased plant facilities soon will shorten the interval between receipt of orders and deliveries. • In the meantime may we express our regrets over unavoidable delivery delays and suggest that you anticipate your future requirements by placing your orders as far in advance as possible?

SPENCER LENS COMPANY • BUFFALO, NEW YORK